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KALRO
Kenya Agricultural & Livestock Research Organization

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

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

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DISCLAIMER

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

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FOREWORD

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

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

Extensive information from research and background data has been used to develop this revised Inventory of TIMPs for the Avocado 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 Avocado 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 Avocado 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
FBS	Farmer Field and Business School
FFS	Farmer Field School
FPEAK	Fresh Produce Exporters Association of Kenya
FAO	Food and Agriculture Organization
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
HRI	Horticulture Research Institute
ICIPE	International Centre of Insect Physiology and Ecology
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
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
NARIGP	National Agricultural and Rural Inclusive Growth Project
NGO	Non-Governmental Organization
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 AVOCADO TECHNOLOGIES, INNOVATIONS AND MANAGEMENT PRACTICES (TIMPS)

1.1 Definition of terms

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

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

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

1.2 Summary of Inventory of TIMPs in the Avocado Value Chain

The inventory process identified 93 TIMPs comprising 41 technologies, 13 innovations and 39 management practices, distributed among the 12 sub-themes, as indicated in the table below.

Table 1: Summary of Avocado TIMPs

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Avocado	Improved avocado varieties	6	0	0
Avocado	Avocado seed system	2	0	1
Avocado	GAPs and food safety	0	0	2
Avocado	Avocado agronomic management practices	2	0	5
Avocado	Soil fertility management	2	1	0
Avocado	Soil and water management	7	0	3
Avocado	Avocado crop health	5	3	15
Avocado	Postharvest management	8	1	1
Avocado	Avocado value addition	2	7	0
Avocado	Mechanization of avocado production activities	7	1	0
Avocado	Avocado business and marketing	0	0	8
Avocado	Innovation platforms, gender and agricultural policy	0	0	4
Total	**93**	**41**	**13**	**39**

1.3 Summary of Status of TIMPs in Avocado Value Chain

The inventory process resulted in a total of 75 TIMPs that are ready for up-scaling, 16 TIMPs that require validation and two TIMPs that require further research in the sub-themes, as

indicated in Table 2.

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

Commodity/VC	Sub-Theme	Ready for up-scaling	Require validation	Further research
Avocado	Improved avocado varieties	6	0	0
Avocado	Avocado seed system	3	0	0
Avocado	GAPs and food safety	2	0	0
Avocado	Avocado agronomic management practices	7	0	0
Avocado	Soil fertility management	0	3	0
Avocado	Soil and water management	9	0	1
Avocado	Crop health	23	0	0
Avocado	Postharvest management	8	2	0
Avocado	Avocado value addition	4	4	1
Avocado	Mechanization of avocado production activities	5	3	0
Avocado	Avocado business and marketing	4	4	0
Avocado	Agricultural policy	4	0	0
	Gender			
Total	**93**	**75**	**16**	**2**

Table 3: Inventory of avocado TIMPs by category and status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Improved avocado varieties	2.1.1 Hass	Technology	Ready for up-scaling
	2.1.2 Fuerte	Technology	Ready for up-scaling
	2.1.3 Pinkerton	Technology	Ready for up-scaling
	2.1.4 Entigger	Technology	Ready for up-scaling
	2.1.5 Puebla	Technology	Ready for up-scaling
	2.1.6 Linda	Technology	Ready for up-scaling
2.2 Avocado seed system	2.2.1. Avocado seed planting	Technology	Ready for up-scaling
	2.2.2. Avocado grafting	Technology	Ready for up-scaling
	2.2.3. Avocado top-working	Technology	Ready for up-scaling
2.3 Good Agricultural Practices and Food Safety Management Systems	2.3.1 Good Agricultural Practices (GAP) for avocado	Management practice	Ready for up-scaling
	2.3.2 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) plan for avocado value chain in Kenya	Management practice	Ready for upscaling
2.4 Agronomic management practices	2.4.1 Nursery establishment and management	Management practice	Ready for up-scaling
	2.4.2 Mulching of trees	Management practice	Ready for up-scaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.4.3 Legume intercropping	Management practice	Ready for up-scaling
	2.4.4. Coppicing	Management practice	Ready for up-scaling
	2.4.5. Pruning	Management practice	Ready for up-scaling
	2.4.6. Avocado spacing recommendation	Management practice	Ready for up-scaling
	2.4.7 Conservation agriculture	Management practice	Ready for up-scaling
2.5 Soil fertility management	2.5.1 Integrated manure management	Complementary technology	Requires validation
	2.5.2 Integrated Soil Fertility Management (ISFM)	Complementary technology	Requires validation
	2.5.3 Rapid soil testing services	Innovation	Requires validation
2.6 Soil and water management	2.6.1 Contour bands	Technology	Ready for up-scaling
	2.6.2 Bench terraces	Technology	Ready for up-scaling
	2.6.3. *Fanya Juu* terraces	Technology	Ready for up-scaling
	2.6.4. Stone lines	Technology	Ready for up-scaling
	2.6.5 Retention ditches	Technology	Ready for up-scaling
	2.6.6 Grass strips	Technology	Ready for up-scaling
	2.6.7 Rain water harvesting systems (roof catchment)	Technology	Ready for up-scaling
	2.6.8 Drip irrigation systems for small scale farmers	Technology	Requires further research
	2.6.9 Rain water harvesting systems(earthdams, roof catchment)	Management practice	Ready for up-scaling
	2.6.10 Basin formation to enhance production in ASALs	Technology	Ready for up-scaling
2.7 Avocado crop health (pest, disease and Weeds)	2.7.1 Integrated management of false coddling moth *(Thaumatotibia leucotreta)*	Management Practices	Ready for upscaling
	2.7.2 Integrated management of Avocado fruit fly, *Ceratitis cosyra, Bactocera invadens, Dacus spp.*	Management practices	Ready for upscaling
	2.7.3 Integrated management of avocado mealybug, *Rastrococcus iceryoides*	Management practices	Ready for upscaling
	2.7.4 Integrated management of avocado thrips, *Frankliniella occidentalis* (Pergande)	Management practices	Ready for upscaling
	2.7.5 Integrated management of avocado hoppers	Management practices	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.7.6 Integrated pest management of avocado aphids	Management practices	Ready for upscaling
	2.7.7 Integrated management of anthracnose (*Collectotrichum gleosporides*) and stem-end Rot (*Lasiodiplodia theobromae*)	Management practices	Ready for upscaling
	2.7.8 Integrated management of powdery mildew (*Oidium perseae-americanae)*	Management practices	Ready for upscaling
	2.7.9 Intergrated management of avocado scab (*Sphaceloma perseae)*	Management practices	Ready for upscaling
	2.7.10 Integrated management of algal spots in avocado (*Cephaleuros.spp)*	Management practices	Ready for upscaling
	2.7.11 Integrated management of avocado sun blotch viroid	Management practices	Ready for up-scaling
	2.7.12 Integrated weed management	Innovation	Ready for up-scaling
	2.7.13 Intercropping system	Innovation	Ready for up-scaling
	2.7.14 Cover cropping for avocado weed management	Technology	Ready for up-scaling
	2.7.15 Mulching for Avocado weed management	Technology	Ready for up-scaling
	2.7.16 Herbicide (Chemical) Weed Control in Avocado	Technology	Ready for up-scaling
	2.7.17 Rapid Response Invasive weed Species (RRIS)	Innovation	Ready for up-scaling
	2.7.18 Solarization Bed for Weed Control in Avocado	Technology	Ready for up-scaling
	2.7.19 Stale seed bed for Weed Control in Avocado	Technology	Ready for up-scaling
	2.7.20 Transplanting	Management Practice	Ready for up-scaling
	2.7.21 Mechanical Weed Control in Avocado	Innovation	Ready for up-scaling
	2.7.22 Crop Rotation in Avocado	Management Practice	Ready for up-scaling
	2.7.23 Safe Use of herbicides	Management Practice	Ready for up-scaling
2.8 Harvest and Postharvest management	24.8.1 Fruit harvesting tool	Management Practice	Ready for up-scaling
	2.8.2 Sorting and grading of avocado	Management Practice	Ready for up-scaling
	2.8.3 Charcoal cooler for avocado storage	Technology	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.8.4 Coolbot^{TM} Cold Storage	Management Practice	Ready for up-scaling
	2.8.5 WakatiTM technology	Technology	Required validation
	2.8.6 Use of crates during packaging, storage, transportation and marketing of avocados	Technology	Ready for up-scaling
	2.8.7 Use of Hexanal to extend avocado shelf life	Technology	Requires validation
	2.8.8 Use of Hot water treatment	Technology	Ready for up-scaling
	2.8.9 Avocado waxing Technology	Technology	Ready for up-scaling
	2.8.10 Modified Atmosphere Packaging of Avocado (Ziploc® and Xtend® bag packaging)	Technology	Ready for up-scaling
2.9 Avocado Value Addition	2.9.1 Avocado oil Processing	Technology	Ready for upscaling
	2.9.2 Processing of avocado into pulp	Innovation	Ready for upscaling
	2.9.3 Processing of avocado into paste	Innovation	Requires validation
	2.9.4 Processing of avocado into sauce	Innovation	Requires validation
	2.9.5 Processing of avocado into canned product	Innovation	Further Research
	2.9.6 Processing of avocado into Frozen Avocado	Innovation	Requires validation
	2.9.7 Avocado stone flour	Innovation	Requres validation
	2.9.8 Avocado Cake	Innovation	Ready for upscaling
	2.9.9 Avocado Chapatti	Innovation	Ready for upscaling
2.10 Mechanization of Avocado production activities	2.10.1 Boom mounted mulcher	Technology	Ready for upscaling
	2.10.2 Pole saw	Technology	Ready for upscaling
	2.10.3 Harrow	Technology	Ready for upscaling
	2.10.4 Tractor operated Hole Auger	Technology	Ready for upscaling
	2.10.5 Portable Hand Operated hole Auger	innovation	Requires validation
	2.10.6 Motorized sprayer	Technology	Ready for upscaling
	2.10.7 Grafting robot	Technology	Requires validation
	2.10.8 Harvesting machine	Technology	Requires validation
2.11 Avocado Farming Business and marketing	2.11.1 Models for market-oriented production of vocadoes	Maanagement practices	Ready for up-scaling
	2.11.2 Building a business plan	Management practices	Ready for up-scaling
	2.11.3 Marketing as a group - collective marketing	Management practices	Ready for up-scaling
	2.11.4 Profitability analysis – performance of Avocado agro-enterprise	Management practices	Ready for up-scaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.11.5 Scaling up plan	Management practices	Requires validation;
	2.11.6 Contracted production model	Management practices	Requires validation;
	2.11.7 Avocado marketing entrepreneurship model	Management practices	Requires validation;
	2.11.8 Internet/mobile marketing	Management practices	Requires validation;
2.12. Agricultural Policies	2.12.1. National Agricultural Framework related to Avocado	Management practices	Ready for up-scaling
	2.12.2 Policy options and objectives related to Avocado farming	Management practices	Ready for up-scaling
	2.12.3 Instruments of policy related to Avocado	Management practices	Ready for up-scaling
	2.12.4 Policy cycle for smallholders' policy issues and implementation	Management practices	Ready for up-scaling
2.13 Gender and VMG mainstreaming			
	Total TIMPs	**93**	

Suitability map of Avocado in Kenya

Figure 1: Suitability map of Avocado in Kenya

2.0 DETAILED AVOCADO VALUE CHAIN TIMPS

2.1 Avocado varieties

2.1.1 Avocado variety: Hass

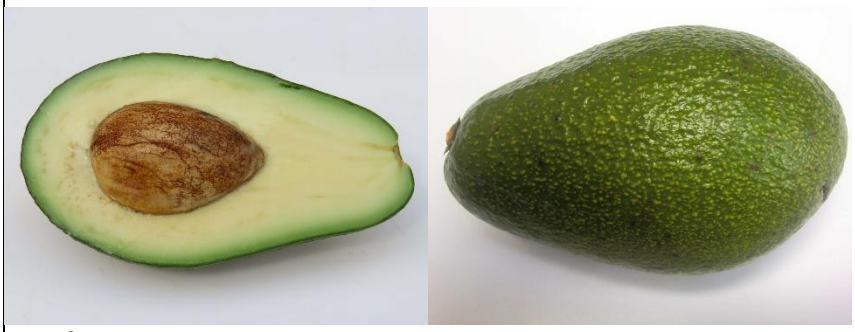
2.1.1. TIMP Name	**Avocado variety: Hass**
Category (i.e. technology, innovation or management practice)	Technology  *Slightly pebbled, leathery oval-pear-shaped fruits* *Source: Lusike Wasilwa, KALRO*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits
What is it? (TIMP description)	A vigorous upright tree which is a consistent bearer. The recommended spacing is 7 x 8 m. The fruit is green at early stages and then brown on maturity. Very slightly pebbled, oval-pear-shaped. Skin is thin and leathery. It's a late variety with small-medium fruit. The fruit length is about 5.5 cm while width is about 6.4 cm. It's a heavy yielder and has excellent eating quality. Oil content is between 18-23%. Average yield of a mature tree is 800 fruits per year.
Justification	Local avocado fruits are of poor quality and are characterized by low oil content. This makes them unappealing to consumers and therefore attracts less returns compared to improved varieties. Availing high yielding, and high quality fruit variety will improve the productivity of avocado farming, enhance household incomes and nutrition. Hass variety being a high yielding variety is a good option for introduction and up-scaling in order to improve productivity and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, agripreneurs, exporters, processors
Approaches 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 variety • Availability and access to markets
Partners/stakeholders for scaling up and their roles	• KALRO undertakes adaptive research on current and other new varieties • KEPHIS to ensure seedling quality is maintained • Private sector e.g. nursery operators to upscale seedling production and availability • Market players to create demand and pull production • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness • NGOs to be involved in the value chain • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bomet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMP will be upscaled	All Avocado growing Counties including Murang'a, Nandi, Kirinyaga, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, , Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Limited and unorganized marketing channels • Poor returns to investment
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 strategies such as contract farming, collective production and marketing
Lessons learned in upscaling 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 upscaling	• Regulatory bodies such as KEPHIS ensure the nurseries are certified • Existing and new export markets are developed and maintained • Policies that encourage agro forestry practices are implemented
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 15,783 (5.5% of total variable costs per acre)

Estimated returns	• A three to five-year-old avocado tree yields 300-400 fruits per year while a tree older than five years gives you 800-1000 fruits (an income of KES 85,860 -717,183 can be made per acre from the third year, increasing in subsequent years in pure stand production.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding and processing activities • Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings • The technology may not be adopted if the gender targeted is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other domestic roles • Distance to the markets can affect participation especially to women due to their domestic roles • Due to social constructs, women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities for women exists in avocado production, processing and marketing while youth can exploit transportation of the produce to the market
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities • VMGs have limited access to agricultural information, technology and knowledge that affect adoption.
VMG related opportunities	• VMGs can commercialize the technology and take transport opportunities for the produce to the market • VMGs can improve their food and nutritional security through consumption of the crop and revenue generation from sale of the produce
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kiambu, Embu, Meru and Nyeri, have adopted the variety
Application guidelines for users	**Reference:** 1. Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI 2. Griesbach, J. (2003). Avocado Growing in Kenya. ICRAF, Nairobi, Kenya
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-Thika; P.O. Box 220-01000 Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thika Njuguna K., and Grace G.
Partner organizations	ICRAF, MoAlD, NGOs

2.1.2 Avocado Variety: Fuerte

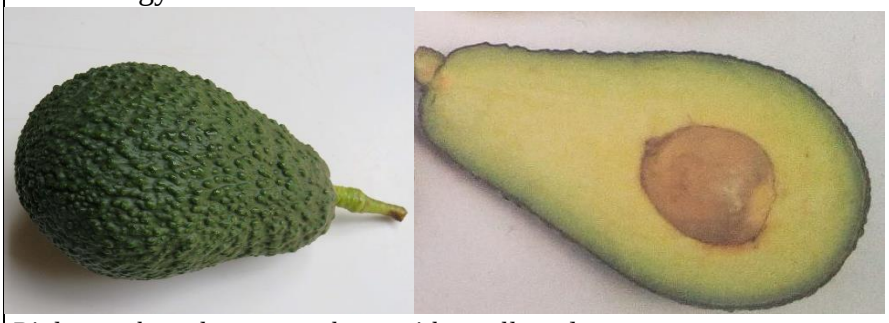
2.1.2 TIMP Name	Avocado Variety: Fuerte
Category (i.e. technology, innovation or management practice)	**Technology**  *The fruit is pear shaped, thin skinned with conical medium seeds**Source: Lusike Wasilwa, KALRO***
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	• It is one of the most popular cultivar for export in many parts of the world. Fruits are green, slightly pebbled with good flavour. The skin is thin and the seed medium and conical. It's a mid-season variety. • Fruit is medium in size (290-380 g). Its pear shaped with 11.3 cm and 7.5 cm in length and width respectively. • The fruit is green even when ripe. Eating quality is excellent but has a tendency towards alternate bearing. The tree is light-medium large and spreading, spaced at 8 x10 m. • Oil content is high at 16-25% • Yield ranges from 800-1000 fruits per tree per year
Justification	• Local avocado fruits are of poor quality and characterized by low oil content. This makes them less appealing to consumers and attracts less returns than the improved varieties. Availing high yielding, and high quality fruit variety will improve the productivity of avocado farming, household incomes and nutrition. • Being ahigh yielding variety, Fuerte variety is a good option for upscaling in order to improve productivity and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, agripreneurs, exporters, processors

Approaches 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
Partners/stakeholders for scaling up and their roles	• KALRO to undertake adaptive research on current and other new varieties • KEPHIS to ensure seedling quality is maintained • Private sector e.g. nursery operators to upscale seedling production and availability • Steady market to create a demand Willing farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • Financial institutions to provide affordable credit facilities
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMP will be upscaled	All Avocado growing Counties including Murang'a, Nandi, Kirinyaga, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Limited and unorganized markets
Suggestions for addressing the challenges	• Establish certified nurseries in the production areas • Establish avocado innovation platforms • Promote appropriate marketing strategies such as contract farming, collective production and marketing
Lessons learned in upscaling 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 upscaling	• Regulatory bodies such as KEPHIS ensure the nurseries are certified • Existing and new export markets are developed and maintained • Policies to encourage agro-forestry practices are implemented.

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs/acre	• KES 15,783 (5.5% of total variable costs per acre)
Estimated returns	• A three to five-year-old avocado tree yields 300-400 fruits per year while a tree older than five years gives you 800- 1000 fruits (an income of between KES 85,860 -717,183 can be made per acre from the third year increasing in subsequent years for pure stand production)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding and processing activities • Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings • The technology may not be adopted if the gender targeted is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other domestic roles • Distance to the markets can affect participation especially to women due to their domestic roles • Due to social constructs, women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities for women exists in avocado production, processing and marketing while the youth in transportation of the produce to the market
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities • VMGs have limited access to agricultural information, technology and knowledge, hence low adoption
VMG related opportunities	• Opportunities for youths exist in commercializing the technology and transportation of the produce to the market • Opportunities exist for VMGs in improving food and nutritional security through consumption of the crop and revenue generation from sale of the produce
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kiambu, Embu, Meru and Nyeri, have adopted the variety
Application guidelines for users	**Reference:** Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). 1. Avocado Manual, KALRO HRI 2. Griesbach, J. (2003). Avocado Growing in Kenya. ICRAF, Nairobi, Kenya
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-Thika; P.O. Box 220-01000 Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thika Njuguna K., and Watani G.
Partner organizations	ICRAF, MoALD, NGOs

2.1.3 Avocado variety: Pinkerton

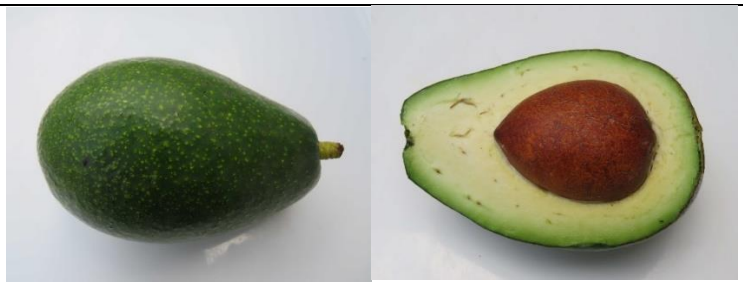
2.1.3. TIMP Name	**Avocado variety: Pinkerton**
Category (i.e. technology, innovation or management practice)	Technology  *Pinkerton have long pear shape with small seeds* *Source: Lusike Wasilwa, KALRO*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	• The tree is of medium size, but more spreading than Hass, bear early, regularly and heavily. Should be spaced at 7 x 7 m • This is mid to late season variety. Long pear shaped which is dark green and normally weigh 250-410 g. • The skin is medium-thick, leathery and pebbled. Has quality pale green flesh and high oil content ranging between 18-20% which is of smooth, creamy texture. • It has a small seed that separate easily from the flesh with coat adhering to the seed. It has good local and export market. • Yield ranges from 800-1000 fruits per fully mature tree
Justification	• Local avocado fruits are of poor quality and are characterized by low oil content. This makes them less appealing to consumers and therefore attracts less returns than the improved varieties. • Availing high yielding, and high quality fruit variety will improve the productivity of avocado farming, household incomes and nutrition. Pinkerton variety being a high yielding variety is 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, agripreneurs, exporters, processors

Approaches 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
Partners/stakeholders for scaling up and their roles	• KALRO to undertake adaptive research on current and other new varieties • KEPHIS to ensure seedling quality is maintained • Private sector e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and therefore increase area production • Farmers/farmer groups to adopt the technology • 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, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok,Kitale, Bungoma, Nakuru, Kisii
Counties where TIMP will be upscaled	All Avocado growing counties including Murang'a, Nandi, Kirinyaga, Meru, Nyeri, Kisii, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Inadequate quality seedlings • Limited and unorganized marketing channels
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 strategies such as contract farming, collective production and marketing
Lessons learned in upscaling 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 upscaling	• 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
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs/acre	• KES 15,783 (5.5% of total variable costs per acre)
Estimated returns	• A three to five-year-old avocado tree yields 300-400 fruits while a tree older than five years gives you 800- 1000 fruits (an income of between KES 85,860 -717,183 can be made per acre from the third year increasing in subsequent years for pure stand production).
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding and processing activities • Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings • The technology may not be adopted if the targeted gender is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities for women exists in avocado production, processing and marketing • Opportunities for youths exists in transportation of the produce to the market
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities • VMGs have less access to agricultural information, technology and knowledge than men • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for youths exist in commercializing the technology and in transportation of the produce to the market • Opportunities exist for VMGs to improve their food and nutritional security and marketing of surplus produce.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kiambu, Embu, Meru and Nyeri, have adopted the variety.
Application guidelines for users	**Reference:** 1. Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI 2. Griesbach, J. (2003). Avocado Growing in Kenya. ICRAF, Nairobi, Kenya

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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thika Njuguna K. and Grace W.
Partner organizations	ICRAF, MoALD, NGOs

2.1.4 Avocado variety: Entigger

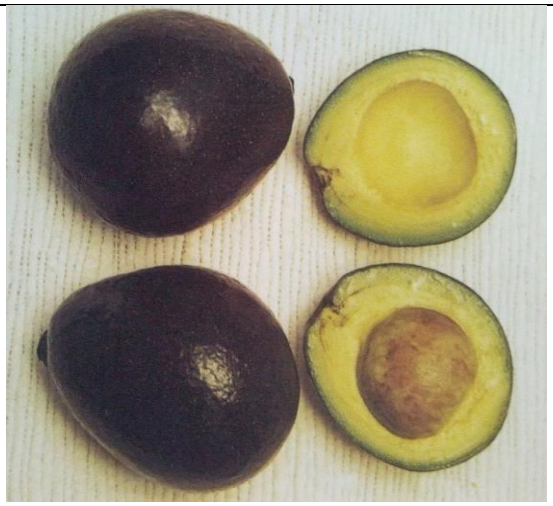
2.1.4. TIMP Name	**Avocado variety: Entigger**
Category (i.e. technology, innovation or management practice)	Technology
	 *Seed is average size and cone shaped* *Source: Lusike Wasilwa, KALRO*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.
What is it? (TIMP description)	The variety grows vigorously and upright. Its light to medium but a regular producer. It has light green, medium sized fruit which is elongated and pear in shape. It weighs between 250-400 g. The skin is thin polished, tough and leathery, which are good attributes for shipping. The flesh is light yellow almost free from fibre, soft melting and ripen uniformly. The seed is average size and cone shaped. It set loosely in its cavity. Has high oil content of 18-22% thus has good eating quality. It ripens at mid-season, slightly before or together with Fuerte. Recommended spacing 7 x 8 m. Yield ranges from 500-800 fruits per mature tree
Justification	Local avocado fruits are of poor quality and are characterized low oil content. This makes them less appealing to consumers and therefore attracts less returns than the improved varieties. Availing high yielding, and high quality fruit variety will improve the productivity of avocado farming and hence household incomes and enhanced nutrition. Entigger variety has good yields, high quality fruits and is a regular bearer. It is

	therefore a good variety for introduction and upscaling in order to improve productivity and incomes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, agripreneurs, exporters, processors
Approaches 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 variety
Partners/stakeholders for scaling up and their roles	• KALRO to undertake adaptive research on current and other new varieties • KEPHIS to ensure seedling quality is maintained • Private sector e.g. nursery operators to upscale seedling production and availability • Market players to createdemand topull production • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • NGOs to be involved in the value chain • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a
Counties where TIMP will be upscaled	All Avocado 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 avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • 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 strategies such as contract farming, collective production and marketing

Lessons learned in upscaling 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 upscaling	• 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs/acre	• KES 15,783 (5.5% of total variable costs per acre)
Estimated returns	• A three to five-year-old avocado tree yields 300-400 fruits while a tree older than five years gives you 800- 1000 fruits (an income of between KES 85,860 -717,183 can be made per acre from the third year increasing in subsequent years for pure stand production).
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding and processing activities • Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings. • The technology may not be adopted if the targeted gender is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities for women exists in avocado production, processing and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities • VMGs have less access to agricultural information, technology and knowledge • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for youths exist in commercializing the technology and transportation of the produce to the market • Opportunities exist for VMGs to improve their food and nutritional security through consumption of the crop
E: Case studies/profiles of success stories	

Success stories from previous similar projects	A few farmers in Murang'a have adopted the variety.
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). *Avocado Propagation* Griesbach, J. (2003). Avocado Growing in Kenya. ICRAF, Nairobi, Kenya
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thika Njuguna K. and Watani G
Partner organizations	ICRAF, MoALD, KEPHIS, NGOs

2.1.5 Avocado variety: Puebla

2.1.5. TIMP Name	**Avocado variety: Puebla**
Category (i.e. technology, innovation or management practice)	Technology
	 *Smooth glossy skin with medium size seeds* *Source: Lusike Wasilwa, KALRO*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity and poor quality fruits.

What is it? (TIMP description)	It's a medium sized and medium season variety. The fruit is ovate. The skin is smooth glossy and purplish red at maturity. The light green flesh is juicy, melting and of good flavor with an oil content of 20%. The seed is medium to large and tightly fixed in its. The tree grows fast with dropping branches but does not set fruit regularly. It's a good pollinator for Fuerte as well as a good rootstock. It's a good yielder 500-800 per tree
Justification	Local avocado fruits are of poor quality and are characterized by low oil content. This makes them less appealing to consumers and therefore attracts less returns than the improved varieties which are of superior quality. Availing high yielding, and high quality fruit variety will improve the productivity of avocado farming and hence household incomes and nutrition. Puebla variety being a high yielding variety is 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, agripreneurs, exporters, processors
Approaches 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
Partners/stakeholders for scaling up and their roles	• KALRO to undertake adaptive research on current and other new varieties • KEPHIS to ensure seedling quality is maintained • Private sector e.g. nursery operators to upscale seedling production and availability • Market players to create a demand and pull production • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • NGOs to be involved in the value chain • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where	All Avocado growing Counties including Meru, Nyeri,

TIMP will be upscaled	Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • 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
Lessons learned in upscaling 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 upscaling	• Regulatory bodies e.g. KEPHIS ensure the nurseries are certified. • Existing and new export markets are developed and maintained
policy and market conditions necessary for development and upscaling	• Policies to encourage agro-forestry practices are implemented.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs/acre	• KES 15,783 (5.5% of total variable costs per acre)
Estimated returns	• A three to five-year-old avocado tree yields 300-400 fruits while a tree older than five years gives you 800- 1000 fruits (an income of between KES 85,860 -717,183 can be made per acre from the third year increasing in subsequent years for pure stand production).
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding and processing activities • Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings • The technology may not be adopted if the gender targeted is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles eg domestic. Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge

Gender related opportunities	• Opportunities for women exists in avocado production, processing and marketing • Opportunities for youths exists in transportation of the produce to the market
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities • VMGs have less access to agricultural information, technology and knowledge • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for youths exist in commercializing the technology and transportation of the produce to the market • Opportunities exist for VMGs to improve their food and nutritional security through consumption of the crop
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kiambu, Embu, Meru. Kisii and Nyeri, have adopted the variety.
Application guidelines for users	**Reference:** 1. Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI 2. Griesbach, J. (2003). Avocado Growing in Kenya. ICRAF, Nairobi, Kenya
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-Thika; P.O. Box 220-01000. Thika Email: Director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thika Njuguna K. and Watani G
Partner organizations	ICRAF, KEPHIS, MoALD, NGOs

2.1.6 Avocado variety: Linda

2.1.6. TIMP Name	Avocado variety: Linda
Category (i.e. technology, innovation or management practice)	Technology  *Oval, purple, thick rough skin when mature and with yellowish flesh* *Source: Lusike Wasilwa, KALRO*
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 tree is not vigorous and has slightly spreading habit. Regular bear and start producing at early age. It is a mid-season variety, varying in shape from oval to elliptical. It's purple when ripe and weigh 250-800g, the thick rough skin is tough and seed small and tight. The melting flesh is yellowish with a very pleasing flavor and has moderate oil content of 10-15 % with no fibre. The recommended spacing is 7 x 7 m. Yield ranges from 500- 800 fruit for a mature tree.
Justification	Local avocado fruits are of poor quality and are characterized by low oil content. This makes them less appealing to consumers and therefore attracts less returns than the improved varieties which are of superior quality. Availing high yielding, and high quality fruit variety will improve the productivity of avocado farming and hence household incomes and nutrition. Linda variety being a high yielding variety is 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, agripreneurs, exporters, processors

Approaches 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
Partners/stakeholders for scaling up and their roles	• KALRO to undertake adaptive research on current and other new varieties • KEPHIS to ensure seedling quality is maintained • Private sector e.g. nursery operators to upscale seedling production and availability • Market players to create a demand that pulls production
	• Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • NGOs to be involved in the value chain • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be Upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of quality seedlings • 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
Lessons learned in upscaling 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 upscaling	• 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.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs/acre	• KES 15,783/- which is 5.5% of total variable costs per acre
Estimated returns	• A three to five-year-old avocado tree yields 300-400 fruits while a tree older than five years gives you 800- 1000 fruits (an income of between KES 85,860 -717,183 can be made per acre from the third year increasing in subsequent years for pure stand production)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding and processing activities • Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings than men • The technology may not be adopted if the gender targeted especially women is overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles eg. Domestic. • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities for women exists in avocado production, processing and marketing • Opportunities for youths exists in transportation of the produce to the market
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities • VMGs have less access to agricultural information, technology and knowledge • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for youths exist in commercializing the technology • Opportunities for youths exists in transportation of the produce to the market • Opportunities exist for VMGs to improve their food and nutritional security through consumption of the crop
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kiambu, Nyeri Embu and Meru have adopted the variety.

Application guidelines for users	**Reference:** 1. Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI 2. Griesbach, J. (2003). Avocado Growing in Kenya. ICRAF, Nairobi, Kenya
F: Status of TIMP readiness **(**1-ready for upsacling; 2- requires validation; 3-requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: Director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Thika Njuguna K. and Watani G
Partner organizations	ICRAF, MoALD, KEPHIS, NGOs

2.2 Avocado Seed Systems

2.2.1 TIMP Name	**Propagation of clean materials through seed**
Category (i.e. technology, innovation or management practice)	Management practice   *Avocado seedlings in potted bags*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Majority of the farmers have no access to grafted seedlings and have always resulted in planting their avocado trees directly from seed. However, the germination rate and vigour of seedlings will be reduced when seeds are obtained from immature fruits. The avocado seed will remain viable for only a short period of time (three to five weeks).

What is it? (TIMP description)	Avocadoes can be propagated directly from seed. If the seed cannot be planted within a few days after its removal from the fruit, then cover it with moist earth, sand, or sawdust in a container until it can be planted. 1. Seed should be washed fully with water to remove the oily coating before planting 2. The conical side of the seed should face upward 3. Only ¾ of the seed should be covered with the media leaving the rest of the seed protruding up 4. It is advisable to improve avocado planted direct from seed by grafting/topworking them in the field This is the most common method of propagation by farmers in the tropics due to the fact that the majority of them cannot access the quality grafted avocado seedlings. This management practice is meant to help avocado farmers grow quality avocado seedlings from seed. This will ensure quality avocado seedlings production and hence quality fruits that will fetch better prices in the market.
Justification	The selection of quality avocado seed from high yielding trees will ensure high productivity. Training of avocado farmers in seed selection and extraction will ensure that the good attributes of the mother plant are maintained.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, nursery owners, agriprenuers, researchers, extension service personnel.
Approaches 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 avocado varieties • A platform for interaction of avocado value chain stakeholders • Development of good seed systems to backstop own seed selection • Seed availability and accessibility through avocado research • Well organized farmer groups and networks • County and central government support • Funding to research, validate and promote seed production

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Systems (NARs) • Nursery owners for quality avocado seed multiplication • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up avocado seedlings production e.g. MESPT, for farmer organization and mobilization • Financial institutions e.g. banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Kiambu, Kirinyaga, Embu, Meru, Nyeri and Kisii
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction among stakeholders • Inadequate quality planting materials for avocado • Low awareness of importance of quality planting materials for avocado in most parts of Kenya
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Research to develop high yielding superior varieties with quality seed • Information dissemination on importance of using good planting materials to increase avocado yields • Train farmers on seed selection and empower their ability to access quality seed • Involve county governments, extension, and nursery operators
Lessons learned in pscaling 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 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 upscaling	• Creation of awareness on nutritional importance of the avocado varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • It is already "a climate change crop" due to its wide adaptation and ability to withstand high temperatures and low rainfall amounts • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 70,000 (For 1000 seedlings) per acre
Estimated returns	• The returns ranges from KES 60,000 to 130,000 depending on management practices
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to education, training and extension services • Avocado trees are considered men's enterprises thereby limiting women control and benefit from them • Women have limited access to agricultural information, technology and knowledge on avocado production • Women and youth have limited access to productive resources such as land, credit, and quality seeds • Women have less access to farm implements
Gender related opportunities	Employment opportunities exist for youth as nursery operators, service providers and marketing of the produce
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) • VMGs have less access to agricultural information, technology and knowledge • 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 and those recovering from drugs as nursery operators, service providers and marketing of the produce • Avocado is nutritious and well adopted in the country hence will act as a food security crop for the VMGs • The technology is acceptable and easy to upscale by all gender categories including the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Avocado production has been very successful and economically important in several parts of Kenya. It is also being cultivated successfully in several countries in the world namely South Africa, United States, and Israel.
Application guidelines for users	**Reference:** Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado

	Manual, KALRO HRI
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO Njuguna K., Gathambiri C., Watani G., Kirigua, V.O., Wasilwa, L.A.
Partner organizations	ICRAF, MoALD , University of Nairobi, NGOs

Research Gaps

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

2.2.2 Avocado grafting

2.2.2. TIMP Name	**Avocado grafting**
Category (i.e. technology, innovation or management practice)	Technology  llustration of grafting(L) and grafted avocado seedlings (R)
A: Description of the technology, innovation or management practice	
Problem to be addressed	Inadequate provision of improved high quality planting materials, long maturity duration and low production (5-7 years for trees sown direct from seed) while those established from grafted seedlings take 2-3 years.

What is it? (TIMP description)	Propagation through grafting starts by raising rootstock from selected local avocado varieties, preferably Puebla. The selected fruits have their seeds extracted and then planted in pre-germination nursery beds. The pre-germinated seeds are then transplanted into polythene bags. After three months the seedlings will have attained pencil size thickness and will be ready for grafting. Scions for grafting are harvested from selected mother plants of the variety intended for propagation. The actively growing part of the rootstock is cut and removed. A wedge shaped vertical cut is made down the stock. A matching wedge cut of the scion of a similar length is made. The scion is inserted to the rootstock and tied together with a grafting tape. The grafting technology helps in reducing the period in which the mature avocado plants starts producing. Avocado plants that are grown direct from the seed will attain maturity and start producing after 5 years whereas those that are grafted will take a period of 2.5 years only. The other advantage of grafted avocado seedlings is that they do not grow too tall compared to those of direct seed.
Justification	There is need for upscaling provision of clean planting materials of improved avocado varieties. Promotion of grafting technology opens opportunities for private sector players as nursery operators, inputs and service providers. Grafting among other nursery operations offers employment opportunities for women, men, youth and marginalized groups. Grafted seedlings take shorter periods to maturity (2-3 years) while trees sown from seed take 5-7 years to start production. Again, the grafting technology is a better way of rapid multiplication for quality seedlings.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Nursery operators • Avocado growers • Agripreneurs • Extension agencies • Traders
Approaches 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 avocado varieties • A platform for interaction of avocado value chain stakeholders
Partners/stakeholders for scaling up and their roles	• KALRO, HRI to provide varieties, seed and production information • Certified seed nurseries for quality seedling multiplication • Market players to create demand hence pull production • Farmers/farmer groups to adopt and plant quality avocado seedlings • County governments, central governments e.g. Chiefs, agricultural extension (Formal and informal) for policy, awareness and dissemination • NGOs to organize and mobilize farmer groups and assist them acquire seedlings • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Embu, Meru, Kiambu, Nyeri and Kirinyaga
Counties where TIMP will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado 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 of avocado seedlings by farmers due to erratic weather • Limited access to approved potting bags
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Increased supply from KALRO KSU nurseries country wide • Build capacity of private sector players and NGOs to supply grafted seedlings
Lessons learned in upscaling 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 has fast-tracked the upscaling 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 necessary for development and upscaling	• Access to suitable and adequate water for the nursery • Access to approved potting bags • 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
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• KES 70,000 (For 1,000 seedlings) per acre
Estimated returns	• The returns ranges from KES 60,000 to 130,000 depending on management practices
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to education, training and extension services • Avocado trees are considered men's enterprises thereby limiting women control and benefits • Women have low access to agricultural information, technology and knowledge on avocado production • Women and youth have limited access to productive resources such as land, credit, and quality seeds • Women have less access to farm implements
Gender related opportunities	• Employment opportunities exist for youth as nursery operators, service providers and marketing of the produce
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) • VMGs have less access to agricultural information, technology and knowledge • 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 and those recovering from drugs as nursery operators, service providers and marketing of the produce • Avocado is nutritious and well adopted in the country hence will act as a food security crop for the VMGs • The technology is acceptable and easy to upscale by all gender categories including the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Increased uptake of KALRO avocado grafted seedlings • Technology adoption among private players and NGOs is increasing
Application guidelines for users	**Reference:** Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI

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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and Scientists	KALRO Njuguna K., Gathambiri C, Watani G, Kirigua, V.O., Wasilwa, L.A.
Partner organizations	ICRAF, MoALD, University of Nairobi, NGOs

Research Gaps

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

2.2.3 Top-working

2.2.3 TIMP Name	**Top-working**
Category (technology, innovation or management practice)	Technology   *Cutting local avocado trees and grafting them*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity due to low yielding variety.
What is it? (TIMP description)	Cutting existing local avocado trees at one metre high and grafting them with scions of improved varieties
Justification	Most avocado orchards consist of old trees that are low yielding. Top working shortens time as well as uniformity in maturity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado growers, agripreneurs, public and private extension service providers

Approaches used in dissemination	• Use of service providers: extension staff; ToTs; demonstrations and field days • Innovation platforms • Farmer Field and Business Schools (FFBS)
Critical/essential factors for successful promotion	• Skilled service providers; • Availability of improved varieties demonstrations
Partners/stakeholders for scaling up and their respective roles	• Extension workers, NGOs, private service providers
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu and Machakos
Counties where TIMPs will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Murang'a, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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
Suggestions for addressing the challenges	• Upscale training services • Training more experts in grafting • Encourage more participation of NGOs/private partnerships
Lessons learned in upscaling, if any	• Availability of cost benefit information enhances adoption • Gradual change of production cycle of aged trees of unknown varieties through grafting is more effective
Social, environmental, policy and market conditions necessary for development and up- scaling	The technology is socially acceptable and environmentally friendly because it involves: i) Rejuvenating aged trees ii) Replacement of unproductive trees with improved (grafted) ones thus the tree population remains the same The improved returns from the top worked trees, are much higher than those from aged trees. There is greater demand of the improved and grafted avocado varieties.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Total cost of grafting one seedling is KES. 56
Estimated returns	• Estimated gross margin (at farm-gate or point of grafting selling) is on average KES. 2,500 taking for example 300 tree @ KES 10 get KES 3,000 for improved trees. The farmers with the ungrafted trees toped worked get about KES 1,500.

Gender issues and concerns in development, dissemination adoption and scaling up	• Women have limited access to education, training and extension services • Avocado trees are considered men's enterprises thereby limiting women control and benefit • Women have low access to agricultural information, technology and knowledge on avocado production • Women and youth have limited access to productive resources such as land, credit, and quality seeds • Women have low access to farm implements
Gender related opportunities	• Employment opportunities exist for youth in implementing the technology as a business
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) • VMGs have low access to agricultural information, technology and knowledge • 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 and those recovering from drugs in implementing the technology • Avocado is nutritious and well adopted in the country hence will act as a food security crop for the VMGs • The technology is acceptable and easy to upscale by all gender categories including the VMGs
E: Case studies/profiles of success stories	
Success stories	• Increased uptake of KALRO avocado grafted seedlings • Technology adoption among private players and NGOs is increasing
Application guidelines for users	1. Pamphlet on avocado grafting –KALRO 2. Mobile app on avocado propagation -KALRO
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	Njuguna K., Gathambiri C, Watani G, Kirigua, V.O., Wasilwa, L.A.
Partner organizations and contacts	ICRAF, MoALD, University of Nairobi, NGOs

2.3 Good Agricultural Practices (GAPs) and Food Safety Management Systems

2.3.1 Good Agricultural Practices (GAP) for Avocado

2.3.1. TIMPs name	Good Agricultural Practices (GAP) for Avocado
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	• Declining food safety • Reduced food quality • Unsustainable farming practices • Reduced environmental impact • Poor workers' safety and health • Inadequate traceability
What is it? (TIMP description)	The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. It is a systematic process of implementing a standardized production system globally that is designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards. It is not about a specific crop production but the process through which production takes place.
Justification	Good Agricultural Practice (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture (by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to continuously improve farming systems. GAP is of utmost importance in protecting consumer health. It requires ensuring safety throughout the food chain. It must be compulsory and transparent and operate not only from the table but also upstream to include suppliers (e.g. fertilizers, plant protection) and all value chain players including providers of logistics and farm equipment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers.
Approaches to be used in dissemination	• 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 government • Applied and adaptive research to test, validate and release improved avocado varieties • A platform for interaction of avocado value chain stakeholders
Partners/stakeholders for scaling up and their roles	Producer organizations, NGO's, MoALD, Private extension providers, CoG and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	• Continuous training of farmers, extension staff and other value chain players • Establish avocado innovation platforms
Lessons learned in upscaling, if any	• Low number of stakeholders are aware of GAP • 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	Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up,	• Most small-scale production systems are centered on women and hence it's them who suffer from the detriments of poor processes; for example, improper application of pesticides results in more women suffering from complications in small scale holdings. This means that adaption of GAPs will increase the benefits of good health to the women, youth and men who work on the farm. • Women and youth have limited access to land for avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to credit than men • Women may not have time and mobility to attend extension

	activities far from home or held at times when they are performing other roles e.g. domestic • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Proper application of GAP will lead to improved health of the various gender categories
VMG related opportunities	• Opportunities for youths and those recovering from drugs exists in avocado production and marketing • Embracing GAPs will lead to food safety for consumers including VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	• Options for certification exist depending on whether it is a single holder certification or group compliance • Compliance is a process and hence takes time, involving continuous improvement processes. • No need for farm sophistication to adopt • There is provision for taking corrective action for all noncompliance at time of assessment • Requires continuous training and exposure to better systems.
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: Kori Njuguna, Ndungu J., Gathambiri C., Wasilwa, L. and Kirigua, V.
Partner organizations and their roles	MoALD, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

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

2.3.2. TIMP Name	**Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Avocado Value Chain in Kenya**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	

Problem addressed	The presence of chemical, biological and physical hazards in the avocado value chain in Kenya have a direct effect on consumer's health thereby constantly increasing demand for high quality crop and it's by products from consumers and public health departments. These hazards have direct economic consequences affecting families, communities and industries involved in the avocado value chain in Kenya. Hazards can lead to reduced productivity of the active population in the country. The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Aspergillus flavus* and *Aspergillus parasiticus*. The chemical hazards due to heavy metal accumulations like lead/mercury/cadmium and Maximum Residue Limits (MRLs) above permitted levels from pesticides have also previously been detected. These hazards cause neurological disorders, cancer and birth defects to the consumers in the value chain.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Points (HACCP) in Avocado value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the avocado supply from biological, chemical and physical hazards into the hands of food management systems. This HACCP system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls. When this HACCP concept is applied to the management of likely adverse health effects resulting from exposure to hazards in the avocado value chain, a wholesome and safe avocado value chain can be maintained improving on trade and health within and beyond Kenyan borders.
Justification	The only important tool kit to assure food safety through monitoring in the Avocado value chain is the Hazard Analysis and Critical Control Points (HACCP) system. This critical tool is already incorporated into the Codex Alimentarius of the world as well as into the national public health food safety legislations of Kenya. The HACCP approach can be applied to all stages of the avocado value chain process, from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer. Through its application, food safety charts in the chain will easily be identified through critical control points. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range requiredThe proposed FSMS that will be adopted, different hazards will be minimized in production, harvesting, processing, distribution and consumption making avocado safe for consumption by Kenyans. Key elements will be identified that will be used or modified to reduce hazards in all steps of production to consumption continuum.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado value chain actors from farmers, traders, food vendors and consumers.
Approaches used in dissemination	• The entire avocado value chain will be evaluated by determining contamination hazards in primary production systems and available control methods for; o Farmer field and business Schools(FFBS) o Agricultural Innovation Platforms (AIP) o Chemical, physical and biological contaminants; o Knowledge on production and post-harvest systems; o Experience in implementation of ICM and IPM; o Experience with principles and practice of HACCP; o GAP, GMP and GHP; o Knowledge of the target market demands on safety. • This HACCP information generated and built on seven principles and actions, i.e.; o Conduct hazard analysis and identification of preventive measures o Identification of critical control points (CCPs) o Establishment of critical limits for monitoring of each CCP o Establishment of corrective action in the event of a deviation from a critical limit o Establishment of record keeping o Establishment of verification procedures • This will be used by stakeholders to address the hazard problems along the value chain in Kenya. • Dissemination of this generated information will be done through; o The national and county level, o common interest groups discussions, o field days and exhibitions, o radio, TV and social media (WhatsApp, Facebook, and X).
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release improved avocado varieties • A platform for interaction of avocado value chain stakeholders • For successful promotion of food safety management system through HACCP in the avocado value chain; o An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the avocado growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards will be formulated. • Distribution of the printed HACCP plan to avocado value chain actors for implementation in order to reduce hazards.

Partners/stakeholders for scaling up and their respective roles.	• Institutions with IPM and ICM programs • Institutions responsible for legislating in food safety, regulations and sale of pesticides • Institutions with the required analytical testing • Training institutions with extension programs to producers and other actors on the chain • Producers and exporters associations • County extension staff • Universities (Public and Private) • NGOs • Private sector, Processors and local traders
C: Current situation and future scaling up	
Counties where already promoted. if any	Murang'a
Counties where TIMPs will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Lack of avocado innovation platforms to facilitate interaction among relevant stakeholders • Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Funding of dissemination platforms
Lessons learned in upscaling, if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • The value chain actors are willing to adopt the HACCP plan if well engaged.
Social, environmental, Policy and market conditions necessary for development and up-scaling	• The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in the value chain. • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
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 and youth have less access to agricultural information, including HACCP Sensitization and training in best practices and adherence to standards should focus more on women and youth.
Gender related opportunities	• Proper application of HACCP will led to improved health of the various gender categories involved value chain activities
VMG issues and concerns in development, dissemination, adoption and scaling up	• To comply with HACCP requirements in the value chain, access to productive resources, credit, inputs and other resources is important • Information needed for compliance with HACCP requirements should be provided to avoid exclusion of VMGs.

VMG related opportunities	• Affirmative action in training and provision of resources required for adherence to the HACCP in the value chain • Increased production will lead to increased consumption and utilization of avocado hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories	N/A
Application guidelines for users	N/A
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requiresvalidation; 3. Requires further research)	Ready for upscaling;
G: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	1. Dr. Kori Njuguna HRI - KALRO Thika 2. M/s. Charity Gathambiri, HRI-KALRO Thika 3. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters 4. Mrs. Violet Kirigua, KALRO Headquarters
Partner organizations	MoALD, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.4 Climate Smart Agronomic Practices

2.4.1 Nursery establishment 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 accessibility to clean planting materials • Inadequate knowledge on nurturing seedlings
What is it? (TIMP description)	• Nurseries are seedbeds where seedlings are nurtured to attain high vigor before they are transplanted to the field. • In nurseries, avocado seedlings are propagated through grafting and resultant seedlings are intensively managed
Justification	• Productivity of avocado orchards is usually affected by the quality of seedling the farmers' plant. Availability of healthy seedlings is a prerequisite for improved productivity and quality of fruits.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado producers, nursery operators 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
Most effective approach	Demonstrations, farmer exchange visits
Critical/essential factors for successful promotion	• Availability of appropriate rootstocks • A suitable site with sufficient water
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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
Counties where TIMP will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Unavailability of nursery site with sufficient amount of water • Ban on sale and use of polybags to pot the seedlings
Suggestions for addressing the challenges	• Sensitization on importance planting healthy and vigor seedlings • Use of alternative potting materials • Have site specific recommendations • Use of alternative biodegradable polybags
Lessons learned in upscaling, if any	Availability of healthy seedlings can greatly enhance both productivity and quality of avocadoes
Social, environmental, policy and market conditions necessary	This technology will enable growing of avocadoes where it would otherwise be impossible.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 50 per seedlings
Estimated returns	KES 200 per seedling
Gender issues and concerns in development, dissemination, adoption and scaling up	• Use of limited land resource for women and youth to develop nurseries for revenue generation
Gender related opportunities	• Employment opportunities for youths exists in operating the nurseries and marketing • The technology is acceptable and easy to upscale by both women and the youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and quality seedlings • VMGs have less access to agricultural information, technology and knowledge • There is low adoption by VMGs due lack of awareness
VMG related opportunities	Establishment of nurseries and sale of seedlings for employment creation
Gender issues and concerns in	Employment opportunities for youths and those recovering

development, dissemination, adoption and scaling up	from drugs exists in operating the nurseries targeting national tree/fruit planting initiatives
E: Case studies/profiles of success stories	
Success stories	• The nursery management has been adopted in Murang'a, Embu and Machakos.
Application guidelines for users	• Selection appropriate rootstock • Site selection • Media preparation and filling in bags • Grafting procedures • Nursery management and care of seedlings
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: Kori Njuguna, Ndungu J., Gathambiri C, Wasilwa, L and Kirigua, V.
Partner organizations	ICRAF, HCD, KEPHIS, MoALD
2.4.2 TIMP name	**Mulching of trees**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture-water stress in the soil; increased emergence of weeds; loss of organic matter; increased soil salinity in the ASALs.
What is it? (TIMP description)	Mulching is the practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop productivity. Mulch in technical term means 'covering of soil' with natural materials such as leaf, straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production.
Justification	Mulching facilitates retention of soil moisture and helps in control of temperature fluctuations, suppresses weeds, improves physical, chemical and biological properties as well as adding nutrients to the soil and ultimately enhancing the growth and yield of avocado. The suppression of evaporation has a supplementary effect as it restricts the rise to the surface of salty water in ASAL project target counties. This salty water raises pH compromising crop growth.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, NGOs
Approaches used in dissemination	• On farm demonstrations during farmer field and business schools • Training in workshops.
Most effective approach	• On farm demonstrations, Farmer field schools, Innovation

	platforms.
Critical/essential factors for successful promotion	• Availability of plant or crop residues. • Size of the land. • Good control on the competing uses of crop residues.
Partners/stakeholders for scaling up and their roles	• County government extension services - Provide link with farmers • Community farmer groups - play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already Promoted	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
Counties where TIMPS should be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Inadequate plant and crop residues due to competing uses • Problem of termite infestation
Suggestions for addressing the challenges	• Crop diversification to increase availability of residues • Adapting alternative mulching materials like high absorbance polymers • Avoid mulch coming into contact with the plant to minimize termite infestation
Lessons learned in upscaling	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	• Capacity building on the importance of mulching • Practical demonstrations on mulching at the farm level • Supporting frameworks/policies at the local level
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is low cost but labour intensive during the initial application, depends also on the type of mulch material (KES 3,925-8,670) per acre.
Estimated returns	Generally more than 100% of the initial investments.
Gender issues and concerns in development and dissemination	Gender responsive-suppresses weeds and reduces time spent for weeding.
Gender issues and concerns in adoption and scaling up	• The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict for those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This may negatively affect the adoption and scaling up. • Since the activity is initially labour intensive and may increase the labour burden for the various gender categories • The TIMP will reduce women's weeding time that can be used performing other productive activities
Gender related opportunities	• The TIMP can offer employment opportunities for the youths.

	• Mulching reduces weeds thus women who perform most of the weeding activities will be relieved to perform other equally demanding economic activities
VMG issues and concerns in development and dissemination	Though easy to use, it is be a bit labour intensive for VMGs, hence its adoption and scaling up may be an uphill task
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Farmers 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	• Shovel away old mulch, debris, and rocks so that you can see the tree trunk. A "mulch volcano" occurs when mulch is piled up year after year on the base of a tree. Mulch piled up at the base of a tree is detrimental and starves the roots of needed oxygen. • Cut up-growing roots with pruners. Up-growing roots can wrap around the base of the tree and kill it over time. If you notice any roots growing upward around the tree as you clear away old mulch, cut them away. • Up-growing roots are a sign that the tree is starved of oxygen. • Remove grass and other weeds with a spade or gardening claw. Scrape the area around the base of the tree to get rid of any weeds or grass. • Adding a proper mulch bed- Spread mulch in a 4–5 feet (1.2– 1.5 m) diameter around the tree. Lay down a thin layer of mulch around the tree. The mulch should not touch the tree itself. Leave (2.5–5.1 cm) of space between the base of the tree and the mulch • Mulch management-Mulch is meant to act as a barrier for weeds and grass. You should pull any weeds or grass that grow out of the mulch bed throughout the year to prevent future growth. You can also use a herbicide, which is a chemical weed killer, around your tree to prevent grass and weeds from growing in your mulch • Rake the mulch occasionally to prevent it from getting packed down. Compacted mulch prevents oxygen from passing through and can starve your tree's roots. • Replenish the mulch once a year. Make it a point to replenish the mulch around the tree once a year. This will prevent weeds, provide essential nutrients, and help with the tree's drainage .
F: Status of TIMPS readiness **(**1 Ready for upscaling; 2 Requires validation; 3 Requires further research)	1. Ready for upscaling 2 .Requires validation in some regions and using different mulch materials

F: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO HRI, Kandara. Njuguna Kori E. Mutuma, P. Kitiem, J. Mwaura, A. Esilaba, J. Wamuongo, D. Kamau.
Partner organizations	County governments

2.4,3 Legume Intercropping

2.4.3 TIMP name	Legume Intercropping
Category (technology, innovation or management practice)	Technology
	 *Intercropping avocado trees with legumes*
A: Description of the technology, innovation or management practice	
Problem to be addressed:	• Decreased yields and resultant low farm returns • Declining soil fertility addresses soil degradation. • Soil erosion problems - runoff are minimized • Weeds infestation – managed using increased soil cover crops • Vulnerability to crop pests - practice helps slow the proliferation of pests and protect yields
What is it? (TIMP description)	Intercropping is a multiple cropping practice involving planting two or more crops in the same piece of land. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. The practice offers the potential to increase yields, enhance soil fertility and minimize the effects of climate change. Single row intercropping: involves the component of avocado and the legumes including (*Mucuna pruriens,* Dolichos Lablab, Cowpeas, *Clitoria ternatea* arranged in alternate single rows. Spacing. The space between the two avocado 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 avocado. Spacing. The inter row spacing between legume is 50-60 cm and legume to avocado is 60 cm. The space between two

	avocado rows is 12 m.
Justification	Climate change is negatively impacting agricultural production. Farmers experience low yields, crop failure, declined soil fertility and generally low farm returns from their investments. Intercropping is one of the potential management practices of enhancing climate change adaptation. It offers the potential to increase yield, enhance soil fertility/biodiversity and minimize the effects of climate change. The practice is known to build healthy soils, control weeds and harness a variety of benefits to increase yields. Intercropping of compatible plants encourages biodiversity by providing a habitat for a variety of insects and soil organisms that would not be present in a single-crop environment.
	The practice has several advantages. First, an intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. Secondly, crop mixtures frequently have lower pest densities, especially of insect pests. The mixture confuses the insects and, if chosen carefully attracts beneficial predators. Finally, intercropping may allow more effective management of cover crops.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, NGOs, and other users
Approaches to be used in dissemination	Demonstrations, Agricultural shows and Extension services
Critical/essential factors for successful promotion	• Awareness creation on the benefits and contribution of the practice to all stakeholders • Easy access of legume varieties that are compatible with avocado • Technical packages describing appropriate schedules of planting intercrop • Package on fertilizer rates and regimes under the practice.
Partners/stakeholders for scaling up and their roles	• County governments – to provide extension services, farmer mobilization and policy formulation • NGOs – to provide support on capacity building and micro- financing services
C: Current situation and future scaling up	
Counties where already promoted	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited access and wide distribution of clean planting materials (intercrop varieties) • Inadequate access of technical materials on the establishment, operations and management of the intercrop • The increased effects of climate change hindering adoption. • Farmer high poverty levels coupled with illiteracy

	especially in deep rural areas of Kenya.
Suggestions for addressing the challenges	• Enhance access of clean planting materials across the counties. Work closely with certified seed merchants, research institutions. • Train and sensitize farmers on the basic principles of intercropping, their benefits and types suitable to their contexts. Use farmer field and business schools and demonstrations • Develop a comprehensive manual on the practice to guide the farmers during the adoption
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. Therefore, farmers can easily adopt this method to significantly cut down on pesticides input costs • The number of ecological benefits provided by this practice can also accelerate upscaling. Intercropping promotes interactions between crops and pollinators, thus supporting biodiversity.
Social, environmental, policy and market conditions necessary	• Socially accepted by both male and female gender. • The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• A technology which involves evaluating trade-offs from an informed or research perspective • Comparatively costly vary between 25-50% depending on the legume mixes
Estimated returns	• Dependent on the legume crop/varieties value chain intercrop
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge • Opportunities for training on benefits of intercropping is required for all gender. Joint household decision making at the household and community levels required for enhanced adoption
Gender related opportunities	Intercropping offers good opportunities to both men and women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits.
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 related opportunities	• Intercropping places emphasis on the importance of using available land space to grow diverse of food crops, increase biodiversity, pest management thus the practice is economically viable for the VMGs
E: Case studies/profiles of success stories	
Success stories	Farmers have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally an increased crop production following application of this widely used and readily available management practice.
Application guidelines for users	Crop rotation on organic farms. A planning manual. SARE 2009.
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Njuguna Kori, P. Ketiem, E. Mutuma, M. Okoti, D. Kamau, V. Wasike, A.O. Esilaba
Partner organizations and contacts	County governments, MoALD

Research GAPS

1. Major information gaps on intercropping performances in specific areas of Kenya. For example, there hasn't been much research on optimal levels of fertilizer use for intercropping avocado and legumes in some areas – the need for site specific validation.
2. Little information on the interactions of various intercrops especially in the arid and semi-arid areas (ASALs).
3. Limited knowledge on resource-use efficiency particularly in regions with impoverished soils (ASALs) and economies where measured benefits is greatest.

2.4.4 Coppicing

2.4.4 TIMP Name	**Coppicing**
Category (technology, innovation or management practice)	**Technology**   *Avocado trees rejuvenating after cut back*
A: Description of the technology, innovation or management practice	

Problem to be addressed	Low productivity, aging trees, tall height hindering pruning and spraying.
What is it? (TIMP description)	Rejuvenating aging avocado through cutting the stump at 1.5 m above the ground
Justification	• Old avocado trees tend to be low producing • They act as host and sources of pests and diseases that attack newly established trees.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneursand extension staff
Approaches used in dissemination	Use of service providers: extension staff; ToTs; demonstrations and field days
Critical/essential factors for successful promotion	Skilled service providers; availability of improved varieties demonstrations
Partners/stakeholders for scaling up and their respective roles.	Extension workers, NGOs, private service providers
C: Current situation and future scaling up	
Counties where already promoted. If any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu.
Counties where TIMPs will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Inadequate service providers • Land ownership challenges • Limited financial capacity among growers
Suggestions for addressing the challenges	• Upscale training services • Training more experts • Encourage more participation of NGOs/private partnerships
Lessons learned in upscaling, if any	• Availability of cost benefit information enhances adoption • Gradual change of production cycle of aged trees through coppicing is more effective
Social, environmental, policy and market conditions necessary for development and up-scaling	The technology is socially acceptable and environmentally friendly because it involves • Rejuvenating aged trees • Replacement of unproductive aged trees with new sprouted stumps • The returns from the rejuvenated trees, improves as a result of coppicing are much higher than those from aged trees • Reduces loss of avocado trees to logging since the old trees are removed leaving a stump for regeneration. The old wood obtained from coppicing can be used for timber wood fuel and other economic purposes.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of coppicing- is low, KES 100 per tree

Estimated returns	a) Cash returns:1 tree yields 60kg @ 100 = KES 6,000 /tree b) Intangible benefits from trees: i) Environmental conservation- preserving water catchments; ii) 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 • Bias in training opportunities in favour of men on coppicing and top-working
Gender related opportunities	• Ease of participation of women since the technology does not require extensive land area. • Reduced tree sizes makes the avocado production system more amenable to intercropping thereby boosting food and nutritional security and incomes among VMGs.
VMG issues and concerns in development, dissemination, adoption and scaling up	Limited access to technical training opportunities among VMGs
VMG related opportunities	• The technology makes management operations such as spraying, pruning and harvesting easy for women, youth and vulnerable persons. • Offers employment opportunities for VMGs as service providers
E: Case studies/profiles of success stories	
Success stories	• Increased uptake of KALRO avocado rehabilitation technology • Technology adoption among private players and NGOs is increasing
Application guidelines for users	1. Pamphlet on avocado grafting -KALRO 2. Mobile app on avocado propagation -KALRO
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO HRI, Kandara. Njuguna Kori KALRO, Mtwapa: F. Pole, F. Muniu, M. Menza, S. Mwashumbe
Partner organizations and contacts	County governments, MoALD

2.4.5 Pruning

2.4.5 TIMP Name	Pruning
Category (technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	
Problem to be addressed	Over grown avocado trees usually exhibit leaf shading, interlocking branches resulting in low photosynthesis and low yields.
What is it? (TIMP description)	• It involves removal of interlocking; low lying and unproductive branches of a mature avocado tree; cutting of the apical bud of the young tree at one metre to allow the tree to spread; and removal of all branches below 0.6 m above the ground for the young trees • Reduction of shading results in creating an environment where disease proliferation is reduced.
Justification	Pruned trees allows light penetration and reduction in disease infection and facilitates better photosynthesis and yields
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado growers, public and private extension service providers, agripreneurs
Approaches used in dissemination	• Use of service providers: extension staff; ToT; demonstrations and field days • Innovation platform • Farmer Field and Business Schools (FFBS)
Critical/essential factors for successful promotion	• Skilled service providers; • Availability of appropriate fungicides
Partners/stakeholders for scaling up and their respective roles.	Extension workers, NGOs, private service providers
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
Counties where TIMPs will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Inadequate service providers • Limited expertise in pruning • Limited financial capacity among growers
Suggestions for addressing the challenges	• Training more experts in pruning • Encourage more participation of NGOs/private partnerships • Resources availed for procuring pruning equipment
Lessons learned in upscaling, if any	Pruned trees give more yields

Social, environmental, policy and market conditions necessary for development and up-scaling	The technology requires adequate community sensitization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer-KES 60,000 and can cover 1,000 trees in a season, Cost of fungicide KES 4,000 per litre.
Estimated returns	High returns expected: Uncontrolled tree-5 kg of avocado, KES 250 a) Controlled tree 30 kg of avocado per tree, KES 2,750 b) Intangible benefits from trees: i) environmental conservation- preserving water catchments ii) 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 participation • Spraying machines are not friendly to women operators.
Gender related opportunities	• Pruning makes management operations such as spraying, pruning and harvesting easy for women • Employment opportunities in spraying exist for youths
VMG issues and concerns in development, dissemination, adoption and scaling up	Limited access to technical training opportunities among VMGs
VMG related opportunities	• Tree size is reduced through pruning making management operations such as spraying, pruning and harvesting easy for women, youth and vulnerable persons. • Prunings can be used as firewood, reducing time otherwise used to gather firewood • Suitable for the youth who become self-employed as service providers in spraying and pruning
E: Case studies/profiles of success stories	
Success stories	• Increased uptake of KALRO avocado rehabilitation technology • Technology adoption among private players and NGOs is increasing
Application guidelines for users	1 Pamphlet on avocado pruning -KALRO 2 Mobile app on avocado seeding -KALRO
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO HRI, Njuguna Kori
Partner organizations and contacts	County governments, MoALD

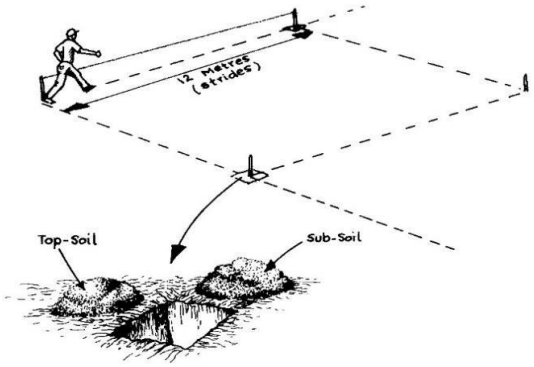
Gaps

- Suitable pruning methods for different varieties under different agro ecological zones

2.4.6 Spacing

2.4.6 TIMP Name	**Spacing**
Category (technology, innovation or management practice)	**Management practice**  *Illustration of correct spacing during planting*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity due to overcrowding and intermingling trees and competition for nutrients.
What is it? (TIMP description)	Establishment of avocado orchards depends on variety. Generally appropriate spacing of 7 m x 7 m is recommended for Hass avocado to achieve a population of 204 trees per hectare
Justification	• Low productivity because avocado trees are randomly planted at close spacing resulting in overcrowding and intermingling of canopy, poor light penetration and difficult to conduct management practices such as pruning and weeding. • Overcrowding increases spread of pests and diseases.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Avocado growers, Public and private extension service providers
Approaches used in dissemination	• Use of service providers: extension staff; ToT; demonstrations and field days • Innovation platforms • Farmer Field and Business School approach
Critical/essential factors for successful promotion	• Skilled service providers; • Availability of improved varieties
Partners/stakeholders for scaling	• Extension workers, NGOs, private service providers

up and their respective roles.	
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMPs will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Inadequate service providers • Land ownership challenges • Inadequate resources
Suggestions for addressing the challenges	• Training growers and service provides • Encourage more participation of NGOs/private partnerships • Resources availed
Lessons learned in upscaling, if any	• Availability of cost benefit information enhances adoption
Social, environmental, policy and market conditions necessary for development and up-scaling	• The technology is socially acceptable and environmentally friendly because it involves replacement of unproductive aged trees with improved (grafted) ones at the right spacing • The returns from the new orchards with improved varieties and grafted are much higher than those from aged trees haphazardly planted
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Costs for string and tape measure for field lay-out are minimal
Estimated returns	a) Cash returns:1 tree at 8 years old yields above 30 kgs of raw fruits @ 150 = KES 4,500 per tree b) Intangible benefits from trees: i)environmental conservation- preserving water catchments
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 • Women and youth have limited access to education, training and extension services • Avocado trees are considered men's enterprises thereby limiting women control and benefit from them • Men dominate decisions on avocado production at the household and community
Gender related opportunities	Opportunities for women exists in the node of nursery establishment where they can operate them as business enterprises
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 by VMGs due lack of awareness
VMG related opportunities	Opportunities for employment exist for youths as service providers in replanting operations
E: Case studies/profiles of success stories	
Success stories	Increased productivity among growers who adopted the practice in Murang'a, Embu, Meru, and Kiambu Counties
Application guidelines for users Manuals and leaflets	 *Illustrattion of field layout*
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO HRI, Kandara. Njuguna K.
Partner organizations and contacts	County governments, MoALD

Research gaps

- Validate spacing recommendations in new growing areas
- Further research on appropriate intercropping systems

2.4.7 Conservation Agriculture

2.4.7 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:	Land degradation characterized by: • Declining soil fertility • Low yields • Increased soil moisture stress • Increased soil erosion

	• Loss of biodiversity
What is it? (TIMP description)	Conservation agriculture (CA) is an approach to farming which can sustainably increase crop yields by conserving the soil, soil moisture, and soil nutrients, and stabilize land production while reducing production costs. Conservation agriculture principles are: 1. Minimal soil disturbance, 2. Permanent ground cover - maintenance of a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops), 3. Crop rotation or sequences and associations of crops including trees, which could include nitrogen-fixing legumes
Justification	Land productivity is decreasing leading to decreased yield. Emission of GHGs are responsible for the changing climate. Conservation agriculture (CA) has potential to: • Enhance management of soil fertility and organic matter, and improvement of the efficiency of nutrient inputs, helping to produce more with proportionally less fertilizer. • Rotations and crop associations that include legumes are capable of hosting nitrogen-fixing bacteria in their roots; this contributes to optimum plant growth without increased GHG emissions induced by fertilizer production. • Avoidance of tillage minimizes occurrence of net losses of carbon dioxide by microbial respiration and oxidation of the soil organic matter and builds soil structure and biopores through soil biota and roots. • The protective soil cover of leaves, stems and stalks from the previous crop shields the soil surface from heat, wind and rain, keeps the soil cooler and reduces moisture losses by evaporation • Helps to reduce soil compaction and plough pans and regenerates degraded lands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, extension agents, researchers
Approaches to be used in dissemination	Agricultural shows , mass media, Chief's Baraza, exhibitions, farmer field schools as well as extension
Most effective approach	Farmer field Schools (FFS), On-farm and on-station demonstrations, Mass media and social media extension
Critical/essential factors for successful promotion	• Training on principles and benefits of CA • Enhance PPP model to support and showcase conservation agriculture with agro-forestry
Partners/stakeholders for scaling up and their roles	• County extension officers - Dissemination of information and capacity building • NGO's (African Conservation Network, One Acre Fund)- Capacity building and dissemination of information • CIAT, FAO – capacity building • County Governments - Funding CA activities, support capacity building, enabling environment and supportive policies
C: Current situation and future scaling up	

Counties where technology is already being promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
Counties where TIMPS will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Non-availability of crop residue in suitable quantities • Competition for crop residues with other uses like wood fuel and as livestock feed • Land tenure (farmers reluctant to invest in CA where they do not have clear land rights) • Limited knowledge on the incremental benefits of CA • Lack of CA implements
Suggestions for addressing the challenges	• Enhance PPP to support increased production and market access • Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of the technology • Allocation of more funds for continued research and dissemination of this technology would aid increased uptake of CA with agroforestry
Lessons learned in upscaling	• Uptake of CA technology increases with the realized incremental benefits over time • Continuous capacity building increases CA technology uptake
Social, environmental, policy and market conditions necessary	• Develop integrated herbicide management plan – pre-emergence and post-emergence herbicides • Reliable technology adoption, suitable price and market access for produce under CA • Continuous capacity building of the community on the benefits of CA technology • County policies that support households investing in CA with inputs like implements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation
Estimated returns	Not yet done
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology may reduce women work burden when it comes to weeding • Women have limited access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities exist for the various gender categories to practice Small Medium Enterprises (SMEs) e.g. tree nurseries. • The technology therefore renders itself to easy adoption by women and youth
VMG issues and concerns in development, dissemination, adoption and scaling up	• Reduces labor demands across all gender categories • VMGs may have less access to credit for crop production

VMG related opportunities	Increased technology uptake will lead to enhanced production, increased consumption and utilization of avocado hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience.
Application guidelines for users	When implementing the three principles of CA, one needs to note the following 1. Timely Operations - preparing the land in good time before the rains start; planting soon after an effective rainfall event; weeding at appropriate times and intervals; doing effective pest and disease control before either spread too widely. 2. Precise operations - Precise measurements of row and plant spacing, evenness of depth and placement of soil amendments and covering of seed are also important. Planting should be done on the same lines each season 3. Inputs – Equipment, seeds, herbicides, manures/fertilizers – use the right inputs 4. Livestock - try to keep livestock out of the fields, even after harvesting the crop. **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 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 upscaling 2=Requires validation 3=Requires further research)	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-Thika;
	P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO HRI. Njuguna K.
Partner organizations	County governments, MoALD

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)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health. • Poor manure management and handling leads to increased Green House Gas (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. It is estimated that soils are depleted at annual rate of 22 kg/ha for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with manure. • Recycling the (macro and micro) nutrients in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. • Given limited access to mineral fertilizers, manure has the potential to provide the limiting nutrients and improving the soil health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs
Approaches used in dissemination	• Open and field days • Exchange visits • Demonstration farms
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 avocado

Partners/stakeholders for scaling up and their roles	• County governments - provide extension services, farmer mobilization and policy formulation • ILRI - technical backstopping • NGOs - micro financing services • AFA – value addition and processing • Processors – value addition • Cooperatives – marketing • Transporters – transport services
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of model demonstration farms • Cultural challenges – avocado training in ASAL communities mainly received by females but main on- farm decisions are made by males • 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 farmers and extension workers • Use of approaches to mobilize farmers to attend demonstration forums
Lessons learned if any	• Proper use of manure improves soil fertility • Use of manure enhances crop productivity • Skills in manure preparation, storage and application are required
Social, environmental, policy and market conditions necessary	• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. • Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbor pathogens which can cause disease outbreaks to avocado • Contamination of water sources by leaching of nutrients • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that minimize GHG emissions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Purchase of one-acre equivalent manure-load (including transport costs) @ KES 8,000 • Labor for application @ KES 6,000per acre

Estimated returns	Based on the response crop (can facilitate experiencing up to over 100% increase of total revenue from sales of the improved crop)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge • Dcisions making at the household and community levels should encourage participation of all gender to enhanced adoption and use of the technology
Gender related opportunities	• Women can have opportunities in manure application and earn an extra income • Youth can do manure making a business in crop production
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to farm inputs such as manures than men • Availing agricultural information, technology and knowledge is crucial for VMGs • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Unemployed youths can have opportunities in manure making business for extra income
E: Case studies/profiles of success stories	
Success stories	• Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income
Application guidelines for users	• ISFM –Integrated soil fertility management in Africa: Principles, Practices and Developmental Process book. TSBF/CIAT • Leaflets
F: Status of TIMP readiness 1=Ready for upsacling: 2=Requires validation; 3=Requires further research	2 = Requires validation
G: Contacts	
Contacts	1. Director Environment & Natural Resources KALRO Secretariat; 2. Institute Director, KALRO–HRI Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: S. Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	County government, Private Public Partnerships

Research gaps

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

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	Declining soil fertility, low organic matter, restoring soil structure and conserving the limited available moisture in crop production.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed combined to adapt practices to local conditions. It places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence).
Justification	• 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 target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. • These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Training in workshops • On-farm visits • Farmer field business schools (FFBS) • Innovation platforms

Critical/essential factors for successful promotion	• Availability of affordable and quality manure, fertilizers and clean planting materials • Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; and • Take into account amount of production resources (land, money, labour, crop residues) that different farming families are able to invest in.
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers. • Community farmer groups; play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
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
Suggestions for addressing the challenges	• Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear misconceptions.
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, among others is required since farmers tend to re-use previously planted materials.
Social, environmental, policy and market conditions necessary	• The practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on choice of the technology options integrated as influenced by the basic input costs.
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by over 50 percent.
Gender issues and concerns in development, dissemination adoption and scaling up	• Women perform most of the crop production activities such as weeding hence the IMM may increase their work burden • Women and youth have limited access to productive resources such as land, credit for purchase of fertilizer, and quality avocado cuttings • Women and youth have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge

Gender related opportunities	Employment opportunities exist for the youth in ISMFoperations
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality avocado cuttings • 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 • It is labour intensive in terms of handling and application hence may disadvantage VMGs.
VMG related opportunities	Opportunities exist for unemployed youth in ISFM operations
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in other crops such as maize in Mtwapa where productivity has been improved.
Application guidelines for users	• ISFM –Integrated soil fertility management in Africa: Principles, Practices and Developmental Process book. TSBF/CIAT • Leaflets
F: Status of TIMP readiness 1=Ready for upsacling: 2=Requires validation; 3=Requires further research	1 =Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO –HRI, Kandara Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: J. K. Njuguna, V.W. Wasike, D. Kamau, A. O., Esilaba, J. Ndufa
Partner organizations and contacts	County governments KEFRI NGOs

Research Gaps

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

2.5.3 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	Poor soil fertility management leads to poor yields and quality in crop production. Both low and excess fertilizer use on crops have

	productive and economic implications on the farm.
What is it? (TIMP description)	This is a dry method for soil testing using simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It requires partners involved (ICRAF, ISDA and Soil Cares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs, extension officers
Approaches tobe used in dissemination	• Farmer visits • Training in workshops • Publicity campaigns done at County levels.
Critical/essential factors for successful promotion.	1. Availability of the necessary equipment for rapid on the spot soil testing. 2. Established rapport between farmers and the technical personnel involved in soil testing. 3. Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins. 4. 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. 5. Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	• County government extension services; providing the link to farmers given that agriculture is devolved. • Soil Cares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF and ISDA tests and validates the recommendation obtained in collaboration with Soil Cares and KALRO. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	
Counties where already Promoted	Technology has not been promoted though testing has been ongoing in a few counties
Counties where TIMP will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira

Challenges in dissemination	• Requires continuous updating methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated mechanisms for updating existing recommendations
Lessons learned in up-scaling 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 Sulphur.
Social, environmental, policy and market conditions necessary	• Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• The cost of analyzing one soil sample isKES. 1,000. • Transaction costs for collecting soil samples (by experts including their transport costs) and dispatch may average 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 750 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	Dependent on the enterprise adopting the service, but estimated at least 30% of current returns.
Gender issues and concerns in development, dissemination adoption and scaling up	• Women and youth have less access to credit to pay for the services • Women have less access to information, technology and knowledge • Women and youth have limited access to education, training and extension services • Men dominant most decisions at the household and community levels
Gender related opportunities	• Bringing services closer to the users saves time and resources to the farmers (men, women and youth).
VMG issues and concerns in development, dissemination adoption and scaling up	• VMGs have less access to farm inputs such as credit to pay for the services • VMGs have less access to agricultural information, technology and knowledge

	• 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	• Offers employment especially for the youth who could be trained as soil sampling champions and later offer the services to help the local communities.
E: Case studies/profiles of success stories	
Success stories	Has been tested and successfully used by other organizations like ICRAF, Soil Cares & KESREF. It has been adopted at Kenya cane testing Centre for checking maturity level and quality of sugarcane.
Application guidelines for users	1. Methods for rapid testing of plants and soil nutrients. In Book manual Sustainable Agriculture Reviews 25 (pp 1-43) 2017. Springer International Publishing. 2. J.R. Okalebo, K.W. Gathua ad P.L Woomer. Laboratory methods of soil and plant analysis: Working manual. Second edition. SACRED Africa 2002.
F: Status of TIMP readiness 1=Ready for upsacling: 2=Requires validation; 3=Requires further research	2= Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO secretariat Institute Director, KALRO–HRI Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: J. K. Njuguna, N, V.W Wasikee, A.O. Esilaba
Partner organizations and contacts	County governments Soil Cares, ICRAF and iSDA

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 the application rates.
3. Developing a fertilizer recommendation system with options for new blends.
4. Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities per farmer needs.
5. Using scanners at farm level to undertake fertilizer quality analysis, 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.

2.6 Soil and Water Management

2.6.1 Contour bunds

2.6.1 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 run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Contour bunds are stone or earthen walls built across a slope to prevent runoff. Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus contour bunds resemble narrow channel terraces commonly referred to as "fanya chini" terraces. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. The aim of contour bunds and hedgerows is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. 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 avocado or millet, can be planted on the ridges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, agripreneurs and extension officers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers. • Innovation platforms • Farmer Field and Business Schools (FFBS)
Most effective approach	Model farm demonstration
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 and 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenge(s) in development and dissemination	• Increased risk of soil erosion if contours are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of contour for efficiency and increased output per man hour. • Training youthful farmers to be champions of contour bunds construction at the Ward level/village level. • Training on site specific designs and construction of contour bunds • Fast-track land registration/titling
Lessons learned, if any	• Terracing is popular largely due to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *contour* preparation. The cost will depend on the land size and the landscape terrain/slope. However, the current market rates/cost are KES. 450 per day .
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	• Ownership of or access to land may limit women in some regions • 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.
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 up-scaling, 2=Requires validation; 3=Requires further research	1 Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: J.K Njuguna., M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations and contacts	County Governments

GAPS

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

2.6.2 Bench terraces

2.6.2. TIMP name	Bench terraces
Category (technology, innovation or management practice)	Technology  *Bench terraces made across the slope*
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Bench terraces consist of a series of beds which are more or less level running across a slope at vertical intervals, supported by steep banks or risers (walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for semi-arid to humid regions of rainfall, 700 mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones.
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, extension service and agripreneurs
Approaches to be used in dissemination	• Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the county extension service providers. • Innovation platforms • FFBS approaches
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 and 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
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 /village level. • Training on site specific designs and construction of bench terraces • Fast track land registration.
Lessons learned, if any	• Terracing is popular largely due 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 aid 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	• Create awareness on the importance of soil and water conservation • Enforce policies on soil and water conservation at the County level • 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 is KES 450per day.
Estimated returns	The returns depends on the value chain being addressed
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 • Men dominate decision making 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 and dissemination	• VMGs have less access to agricultural information, technology and knowledge • 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 and labour demands
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 upscaling, 2=Requires validation; 3=Requires further research	1 Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: J.K. Njuguna, M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations and contacts	County Governments

2.6.3 Fanya Juu Terraces

2.6.3 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 run off; low soil water retention capacity in most soils
What is it? (TIMP description)	'Fanya juu' terraces (juu is Swahili word for 'up') are constructed by excavating soil and throwing it up-slope to make an embankment. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as avocado, 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, extension service and agripreneurs
Approaches to be used in dissemination	• Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive • Farmers and extension service with skills to design and construct the terraces • 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 and 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
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' terrace construction at the Ward/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. • 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	• Create awareness on the importance of soil and water conservation • Enforce policies on soil and water conservation at the County level • 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	The returns depends on the value chain being addressed
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 education, training and extension services • Decision making in technology adoption is mainly male dominated at household and community levels
Gender related	• Potential to create employment for youth through

opportunities	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, if hired, in 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
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 more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of trenches in hillside to trap runaway water and soil.
Application guidelines for users	• A guide for selecting the right soil and water conservation practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICAF).
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	J.K. Njuguna, Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	County Governments extension service.

2.6.4 Sone lines

2.6.4 TIMP name	**Stone lines**
Category (technology, innovation or management practice)	Technology

	 *Making stone lines to slow down run off*
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Is a soil and management option where stones are placed along contour lines to slow down run-off. 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, extension service and agripreneurs**
Approaches to be used in dissemination	Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct 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 labour. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu

County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
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 adopt.
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For each acre, transport and other project costs amount to around KES 10,120
Estimated returns	The returns depends on the value chain being addressed
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 education, training and extension services • Decision making in technology adoption is mainly male dominated at 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,	• VMGs have less access to agricultural information, technology and knowledge
dissemination, adoption and scaling up	• 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	Stone lines are built along the contours. The lines are between 0.5 and 1.5 m high, depending on the gradient of the slope. The distance between stone lines ranges from 25 to 40 m. Each hectare needs between 30 and 50 tons of stones, which are built into contour lines about 300 m long. The stone lines slow the fast-flowing rainwater, thereby reducing erosion. This allows up to 200 more litres of water to penetrate the soil per square metre. The amount of work involved is considerable: to quarry the stone, load it onto lorries and line it on the fields.
F: Status of TIMP readiness 1. Ready for up-scaling, 2=Requires validation; 3=Requires further research	1 Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	J.K. Njuguna, Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	County Governments extension service, NGOs.

2.6.5 Retention ditches

2.6.5 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 run off, affecting nutrient availability for crop production
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. The technology is suitable in harvesting water in semi-arid areas;

	permeable, deep and stable soils; and on flat or gentle sloping land.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension service and agripreneurs
Approaches to be used in dissemination	Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools • Training in workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	• Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct the retention ditches. • 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 and capacity building • Community farmer groups – Provide on-farm demonstration plots to hold farmer field schools; provide collective labour. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok and Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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	• Create awareness on the importance of soil and water conservation • Enforce policies on soil and water conservation at the County level • 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 labour is KES 450per man-day s
Estimated returns	The returns depend on the value chain being addressed
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 education, training and extension services • Decision making in technology adoption is mainly male dominated at 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 and dissemination	• 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 • VMGs have limited access to training and extension services • 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.
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	A guide for selecting the right soil and water conservation

users	practices for small-holder farming in Africa. Technical manual No. 24. World Agroforestry Center (ICAF).
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	J.K. Njuguna, Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	County Governments extension service.

2.6.6 Grass strips

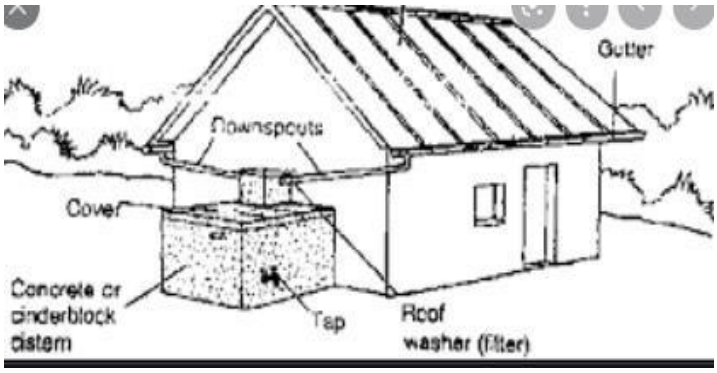
2.6.6 TIMP name	**Grass strips**
Category (technology, innovation or management practice)	Technology  *Well established grass strips to control soil erosion*
A: Description of the technology, innovation or management practice	
Problem to be addressed	The risk of soil erosion and increased run off
What is it? (TIMP description)	Grass strips are dense strips of grass panted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively good rainfall. The technology is suitable in regions with fairly gentle slopes (0 - 6%); grass is needed for fodder; and

	high rainfall areas.
Justification	Agricultural production is threatened in many parts of the Kenya by soil moisture stress and serious soil erosion. Conservation of soil and moisture through construction of grass strips has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	**Farmers**
Approaches to be used in dissemination	Approaches to be used in the dissemination include: • On-farm demonstrations during farmer field schools • Training in Workshops. • Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.
Critical/essential factors for successful promotion	• Availability of labour • 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 also used as mulch for crops by farmers.
Social, environmental, policy	• Enforce policies on soil and water conservation at the

and market conditions necessary	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	The returns depend on the value chain being addressed and also type of grass
Gender issues and concerns in development, dissemination, adoption and scaling up	• 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	• 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
VMG issues and concerns in development and dissemination	Opportunities exist for VMGs exists in provision of labour
VMG related opportunities	• 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
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 (ICAF).
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-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	J.K. Njuguna., Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	County Governments extension service.

2.6.7 Rainwater harvesting systems (roof catchment)

2.6.7 TIMP name	**Rain water harvesting systems (roof catchment)**
Category (technology,	Management practice
innovation or management practice)	 *Illustration of roof water catchment*
A: Description of the technology, innovation or management practice	
Problem to be addressed:	Water scarcity for crop and livestock use especially in the face of diminishing rainfall because of climate change
What is it? (TIMP description)	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. One method of rainwater harvesting is rooftop harvesting and harvesting through earth dams.

Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage. By collecting, storing and utilizing water agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high-value crops, and extending their growing season through the entire year. Technology also slows water runoff and increases yields with the additional water.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, pastoralists and agro-pastoralist
Approaches to be used in dissemination	• Demonstrations on technology use; Farmer Field Schools; Technical training and re-tooling of extension personnel; Awareness creation through various platforms like local FM stations
Critical/essential factors for successful promotion	• Avail resources (human, technical and financial) to support acquisition and establishment of water harvesting systems • Policy to support use of communal land to establish and manage the earth dams • Policies supporting Public-Private Partnerships in water harvesting • Sensitization of local communities to embrace the practice
Partners/stakeholders for scaling up and their roles	• Private sector – access to technology, access to credit, technology installation • County government – capacity building, policy support, credit facilities, • NGOs – access to technologies, capacity building, technology installation
C: Current situation and future scaling up	
Counties where already promoted	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
County where TIMP will be promoted	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
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

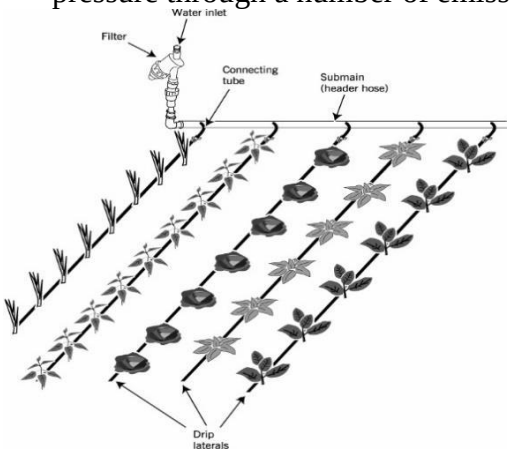
	monitoring and maintenance. • Vandalism • Some systems require high investment costs.
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engaging a participatory process during the planning and implementation of the project. • User specific training 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 up- scaling, if any	• Potential to caution community against water scarcity • Improved productivity where water harvesting has been implemented.
Social, environmental, policy and market conditions necessary	• 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	• Needs to be determined on a case-by-case basis with respect to the farm terrain and desired scale of water harvesting
Gender issues and concerns in development and dissemination	• Men dominate most decisions at the household and community levels
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 will reduce women's time burden of walking far distances in search for water • The technology requires heavy capital investment that may be out of reach for women • Women have less access to land for dam construction • Women have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Potential for youth employment during implementation of the technology

	• Water harvesting save the time spent for fetching water especially by women. The saved time will be channeled into other economic activities
E: Case studies/profiles of success stories	
Success stories	Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres. This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	Agro-pastoralists and farmers in target counties need training and empowerment on the technology and attendant management practices. 1. Handbook on Rainwater Harvesting and Storage Options 2. Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen
F: Status of TIMP readiness 1. Ready for up-scaling, 2=Requires validation; 3=Requiresfurther research	1 Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	Njuguna J.K., Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba
Partner organizations and contacts	County Governments extension service.

Research GAPS

1. Development of models of rain water harvesting for intensive agricultural production and household use.
2. Research on mulching using factory/industrial wastes, including mushroom, tea, and coffee, among others in different value chains is required.

2.6.8 Drip irrigation systems for small scale farmers

2.6.8 TIMP name	Drip irrigation systems for small scale farmers
Category (technology, innovation or management practice)	Technology
	 *Drip irrigation system in Avocado*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Increased crop water stress caused by seasonal rainfall variability in rainfed 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)  *Layout of a drip irrigation system in vegetables*
	• 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 is easy to design and operated. The layout can either be above surface or buried below the surface. 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	Farmers, Nursery operators, Researchers, Agripreneurs
Approaches 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) to minimize water inefficiencies • Training of farmers and extension staff • Drip management skills
Partners/stakeholders for scaling up and their roles	• County governments; capacity building, supportive policies and frameworks • Private sector (e.g. AMIRAN); facilitate access to technology; technology demonstration; access to credit • NGOs (e.g. 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
County where TIMP will be promoted	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs • High temperatures experienced in ASALs causing water salinity challenges • Drip poly-tubing may 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 (e.g. use of PVC pipes) to manage clogging and allow free flow of water • Regular maintenance of the system especially the drip filters to flush out accumulated salts that clog emitters • Intensive farmer training on the management of drip irrigation system

Lessons learned	• Drip system increases yield, incomes and food security • Link farmers with markets for enhances sustainability • Cover the soil with organic matter (crop residue or green manures) in a drip system helps preserve moisture and additional nutrients to the soil • Link farmers to Micro Finance Institutions for financial needs
Social, environmental, policy and market conditions necessary	• Capacity building for increased awareness • Policy support for increased investments in drip irrigation systems • Water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Inputs materials include water source, drip lines, drippers, and pumping unit, filtering and fertilizing systems • Implementation on ¼ acre piece of land costs between KES 50,000 to KES 100,000
Estimated returns	• Opportunity for farmers to increase crop yields • Income increase from effective management of crop water stresses can be as high as 35% • System provides efficient fertilizer usage (fertigation) with irrigation water • Drip system also increases water saving hence availing water for other competing needs • Drip application of water to the plants is up to 27% more as compared to other irrigation systems
Gender issues and concerns in development, dissemination, adoption and scaling up	• Drip systems are easily installed and therefore suitable for both male and female gender • Drip system tend to reduce workload for all gender and provides significant positive impact on family food and nutritional intake • Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems. This may increase their labor hours • Acceptable and easy to scale up by both male and female, including youth
Gender related opportunities	Opportunities available for women and men to generate sustainable income
VMG issues and concerns in development, dissemination, adoption and scaling up	The technology fits well with the VMGs and easily installed and manageable, thus improving nutrition for the VMG
VMG related opportunities	Drip technology reduces the workload to the VMGs and provides an opportunity for business as they are mostly done on high value crops such as avocados and other vegetables
E: Case studies/profiles of success stories	

Success stories	There are many successful drip irrigation farmer models across the country implemented by government and other development partners. It is noted that linking markets to crops under drip is crucial for sustainability
Application guidelines for users	1.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 Small-scale Vegetable Production. AVRDC – The World Vegetable Center, Shanhua, Taiwan. AVRDC Publication No. 09-723. 83 p. 2. 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. 3. 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/a-i3765e.pdf
F: Status of TIMP readiness 1. Ready for Upscaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and Scientists	KALRO: Njuguna J.K.; Wairimu M.; Kitiem P.; Mwaura J.; Kamau D.; Esilaba A.O.
Partner organizations and Contacts	AMIRAN Kenya, HortiPro, SunCulture, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

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.

2.6.9 Rainwater harvesting systems (Earth dams, roof catchment)

\2.6.9 TIMP name	**Rain water harvesting systems (Earth dams, roof catchment)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Water scarcity for crop and livestock use especially in the face of diminishing rainfall because of climate change

What is it? (TIMP description)	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient. One method of rainwater harvesting is rooftop harvesting and harvesting through earth dams
Justification	• Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage • By collecting, storing and utilizing water for agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high-value crops, and extending their growing season through the entire year. The technology also slows water runoff thus increasing yields with the additional water
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Agripreneurs
Approaches 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	Demonstration and Farmer Field School
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 technology is already being promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMPS will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Cost and labour intensive • Communal conflicts where land is communally owned (the tragedy of the commons) • High level skills may be required especially for the operation and maintenance that might be out of reach for the local community
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engage a participatory process during the planning and implementation of the project • Train the local community on maintenance and operation skills
Lessons learned in upscaling if any	Potential to caution the community against water scarcity
Social, environmental, policy and market conditions necessary	• 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 yet determined
Estimated returns	Not yet determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology will reduce women's time burden of walking far distances in search for water • The technology requires heavy capital investment that may be out of reach for women • Women have less access to land for dam construction • Women have less access toagricultural information, technology and knowledge.
Gender related opportunities	• Potential for youth employment during implementation of the technology • Water harvesting save the time spent for fetching water especially by women. The saved time can be channeled into other economic activities

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 • VMGs have limited access to land for dam construction • VMGs have less access to agricultural information, technology and knowledge.
VMG related opportunities	The technology will reduce the time burden of fetching water by the VMGs
E: Case studies/profiles of success stories	
Success stories from similar previous projects	• Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods • A typical African Water Bank rainwater harvesting system with an artificial roof of 900 to 1,600 square metres and storage tanks, collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. The largest tank constructed is 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 L/ 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 ASALs, rainwater harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	Agro-pastoralists and farmers in target counties need training and empowerment on the technology and management practices.
F. Status of TIMPS readiness 1 = Ready for upscaling; 2 = Requires validation; 3 = Requires further research	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038.
Lead organization and scientists	KALRO: Njuguna J.K.; Wairimu M.; Kitiem P.; Mwaura J.; Kamau D.; Esilaba A.O.
Partner organizations	County government, PPP

GAPS

1. Test and adopt CSA technologies for slowing down siltation of earth dams.
2. Work with locals to identify centralized location where to establish communal earth dams.
3. Research for cheaper technologies for water storage structures at the farm level.
4. Quantify economic returns of different water harvesting systems or technologies in the ASALs
5. Analyze the potential and the implications of up-scaling of water harvesting on a watershed and/or community scale
6. Balance between water harvesting for economic production and natural water harvesting for ecological production and service delivery in a watershed

7. Understand the biophysical and socio-economic conditions different WH systems optimally perform
8. Economics of the TIMPs need to be determined

2.6.10 Basin formation to enhance production in ASALs

2.6.10 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, 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
Most effective approach	Demonstration
Critical/essential factors for successful promotion	Supporting farmers with equipment and skills
Partners/stakeholders for scaling up and their roles	County governments and NGOs
C: Current situation and future scaling up	
Counties where already promoted	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMPS should be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
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 upscaling	Huge potential to increase farmers' resilience especially in ASALs.
Social, environmental, policy and market conditions necessary	Environmentally, it conserves water and soil erosion and generally boost biodiversity. Presently, there are no policies to regulate the technology.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The labour for basin formation is estimated at KES 40 to 100 each
Estimated returns	• Opportunity for farmers to increase crop yields • Increase in income as a result of management of crop water stresses can be as high as 35%.
Gender issues and concerns in development, dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened • Women have less access to agricultural information, technology and knowledge than men • Women and youth may also have limited access to finances to buy the required Implements than men
Gender related opportunities	• Employment opportunity exist for youth during implementation • The technology is acceptable and easy to upscale by both males and female gender
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for avocado cultivation than men • VMGs may also have limited access to finances to buy the required implement than men • Women have less access to agricultural information, technology and knowledge than men • The technology is labour intensive and may be difficult for the VMG to implement in the field
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production will lead to increased consumption and utilization of avocadoes and hence improved health of VMGs
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 1 meter width
F. Status of TIMPS readiness 1) Ready for upscaling; 2) Requires validation; 3) Requires further research	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone:

	020-2055038.
Lead organization and scientists	KALRO: Njuguna J.K.; Wairimu M.; Kitiem P.; Mwaura J.; Kamau D.; Esilaba A.O.
Partner organizations	NGOs , Extension

2.7 Crop Health Integrated Management of Pests, Diseases and Weeds

2.7.1 Integrated management of false coddling moth *(Thaumatotibia leucotreta)*

2.7.1 TIMP Name	**Integrated management of false coddling moth *(Thaumatotibia leucotreta)***
Category (i.e. technology, innovation or management practice)	Management practice
	  *Brown larvae on avocado fruit skin by (Source: PHA, 2019)* *Lesions on the avocado FCM larvae* *(Source: De Vi Van den Berg)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop loss due to infestation by false coddling moth
What is it? (TIMP description)	Integrated management of false coddling moth uses various approaches in management of the pest and applied in the field, pre-harvest and postharvest stages. These approaches include: cultural management, mechanical approaches, use of tolerant varieties and chemical control. **Pre-harvest management practices** **Cultural practices** • Hang yellow thick polythene sheets pasted with gel/sticky surface about five feet by two feet close to the crops. • Ensure that sanitation and field hygiene practices are adhered to by collecting and disposing infected fruits, leaves, and twigs. • Collect fallen fruits and destroy by burying at least 40cm deep to the soil to prevent FCM larvae from emergence. • Ensure that pruning is undertaken to remove infected twigs and also improve on air circulation. • Ensure that the orchard is weeded and other agronomic practices are carried out. • Avoid inter-planting avocado with beans, grape, citrus, guava, chilli, pepper, pomegranate, and pineapple that are susceptible to attack by the false coddling moth. • Use mesh or net barriers to keep the pest out of the crop or

	hand pick the mature larvae from the crop. • Use sex pheromone traps to monitor the adult moths and increase the pheromone traps density to 2 traps/acre to control the pest. **Biological control** • Use traps such as CRYTRACK from Kenya Biologics at one trap per acre with action thresholds of 5-7 moths caught/ acre/ trap/ night • Use BACIGUARD 16WDG 15g/ 20 L and repeat sprays after 14 days interval • Use *Bacillus thuringiensis* (Bt) at 0.49 kg/acre to effective manage this pest • Spray with entomopathogenic fungus, beauvaria products such as Beauvitech at rate 10g/ 20 L water. Spray at interval of 7 days • Use entomopathogenic nematodes (*Heterorhabditis bacteriophora*) based products such as larvanem at 500,000 nematodes/ sachet for 100 square meter **Chemical management** • Apply insecticides from flower-bud formation stage until when fruits are fully developed. The most susceptible stages are bud-formation, flowering period and early fruit development • Spray lambda cyhalothrin products such as Pentagon (10-15 ml/ 20 L) • Spray with indoxicarb based products such as Indox at the rate of 10 ml/ 20 L water • Spray deltamethrin based products such as Atom 2.5EC, Decis 2.5 EC etc at the rate of 10-15 ml/ 20 L of water; contact pyrethroid. pesticide with residual activity or spray cyhalothrin 2.5% w/v (10-15 ml/ 20 L) such as Karate
Justification	False coddling moth is a pest majorly causing up to 60% postharvest losses and reduced shelf life in avocado in all growing regions in Kenya. Postharvest losses occasioned by this pest lead to reduced returns for the farmers in terms of quality, marketability and thus negatively impacting on food and national security of the country
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Agripreneurs
Approaches 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 avocado varieties with superior yields and quality • A platform for interaction for all avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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, national 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, Kiambu, Nyeri, Embu, Meru, Uasin Gishu, Nakuru, Bungoma, Trans Nzoia, Nandi, Narok, Bomet
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management. • Limited number of farmer groups. • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders.
Suggestions for addressing the challenges	• Establish avocado 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 upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the pest and diseases. • 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 upscaling	• Regulatory bodies e.g. PCPB, KBS to ensure pest control products sold to farmers are genuine and of high quality. • Producers willing to adopt the integrated pest and disease management practices. • Producers organized in groups to ensure that management practices are effectively up-scaled. • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	KES 6, 200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs.
Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities for youth as service providers e.g. in spraying with chemicals
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying. • VMGs have less access to information, technology and knowledge. • VMGs may have less access to labour.
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kirinyaga, Embu and Meru have adopted the management practice
Application guidelines for users	Plantwise Knowledge Bank
F: Status of TIMP readiness (1-ready for up-scaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Njuguna J.K.; Otipa M.J.; Wasike, V.W.; Mwaura S.; Too A.; Gathambiri C.
Partner organizations	ICRAF, CABI, KOPPERT, Real IPM

2.7.2 Integrated management of Avocado fruit fly, *Ceratitis cosyra, Bactocera invadens, Dacus spp.*

2.7.2 TIMP Name	**Integrated management of Avocado fruit fly, *Ceratitis cosyra, Bactocera invadens, Dacus spp.***
Category (i.e. technology, innovation or management practice)	Management practice   *Adult fruit fly Fruit fly damage on avocado (Source: infornet- biovision)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop loss due to infestation by fruit fly, *Bactrocera* spp.
What is it? (TIMP description)	Integrated management of false fruit fly uses various approaches in management of the Avocado fruit fly that are applied during pre-harvest and postharvest stages. These approaches include: cultural, biological, mechanical and chemical control options **Cultural practices** These are sustainable options that are aimed at reducing crop pest infestation employing environmentally friendly techniques such as; • Removing neglected (unmanaged) alternate host plants like guava, chilli, citrus, melon, coffee, avocado, or wild fruits to reduce pest population • Pruning regularly to improve aeration and reduce on the hiding areas • Bagging fruits using old newspapers measuring 15 x 22cm to prevent fruit flies from laying eggs on fruits

	• Harvesting early when crop is mature and green because over-ripened fruits attract fruit flies • Preserving the natural enemies like ants, rove beetles, birds and parasitic wasps by planting hedge rows or wild flower strips of *Lantana camara,* or release poultry in the orchard to feed on pupa at the base of plants • Increase the pheromone traps density to 2 traps/hectare to monitor the pest. Use of lure pheromones will lead to reduction of female fruit flies and hence low damage of avocado fruits. The traps take away 90% of the fruit flies and save the fruits from damage. This would translate to fruit yield saving of greater than 10 tons/hectare **Biological control** • Use traps and baits. The traps should contain ½ cup (150 ml) of vinegar mixed with water and 4-6 drops liquid soap or 20 ml of vinegar/acre) • Trap flies using commercial pheromone traps - Methyl Euginol (Bactrolure liquid) at 20 traps/acre. • Spray neem extracts e.g. Achook 0.15% EC at 20 ml/20 L water. • Remove infested fruits (e.g. those with dimples and oozing sap) twice a week and destroy by burying about 60cm deep, tying in black plastic bag and leaving in sun for 3 days, or putting in boiling/hot water to kill larvae and then feed to poultry or pigs • Store harvested fruit in cool place or cold storage for 5 days. • Flood around the base of trees with water weekly to kill pupae and adult emergence
	Chemical management • Spot treat affected trees with poison baits of molasses with deltamethrin (Decis 2.5 EC) or bifenthrin (Brigade 25 EC or defender 2.5% EC) or Buprofezin (Applaud 40% SC). • Use pyrethrin extract (e.g. Flower DS) at a rate of 60 ml/20 L water every 5 days to two weeks depending on infestation severity. Start applications shortly after flowering
Justification	Over 40% yield loss of avocado fruits are being experienced in the production regions due to rotting and early fall of avocado fruits. This could be prevented by trapping the flies before fruit ripening stage using the area wide approach. Pheromone traps are commercially available and farmers need to be capacity build, on their use and application in the management practice. Through Information Platforms (IPs) and Farmer Field and Business Schools (FFBS) where Training of Trainers (ToTs) can be carried out, knowledge sharing is promoted in such forums. Farmers experiences and lessons learned will be shared in such fora.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Producers, Exporters, Agripreneurs
Approaches 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 avocado varieties tolerant to fruit fly infestation • Avail platform for interaction of avocado value chain stakeholders • Adoption of appropriate agronomic practices • Well organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in fruit fly management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of pest control products for pest and disease management • Farmers/farmer groups to adopt the technologies • County and national governments to develop 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, Kiambu, Nyeri, Embu, Meru, Uasin Gishu, Nakuru, Bungoma, Trans Nzoia, Nandi, Narok, Bomet
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Disseminate integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing

Lessons learned in upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • 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 upscaling	• Regulatory bodies e.g. PCPB and KEBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200 per acre on average in the first three years (establishment of crop). Labour and inputs account for about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652 per acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Employment opportunities for youth as service providers e.g. in spraying with chemicals
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kirinyaga, Embu and Meru have adopted the management practice.
Application guidelines for users	Plantwise Knowledge Bank

F: Status of TIMP readiness 1 =ready for up-scaling; 2 = requires validation; 3 = requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalr o.org Phone: 020- 2055038
Lead organization and scientists	KALRO: Njuguna J.K.; Otipa M.J.; Wasike, V.W.; Mwaura S.; Too A.; Gathambiri C.
Partner organizations	ICRAF, CABI, KOPPERT, Real IPM

2.7.3 Integrated management of Avocado Mealybug, *Rastrococcus iceryoides*

2.7.3 TIMP Name	**Integrated management of Avocado Mealybug, *Rastrococcus iceryoides***
Category (i.e. technology, innovation or management practice)	Management practice   *A colony of mealybugs on avocado leaf (Source: infonet.biovision)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop loss due to infestation by Avocado mealybug leads to low productivity and poor quality fruits due to invasive by mealybug. The damage by the mealybugs can result in 40-80% yield reduction that leads to no export of the fruits due to importing country quarantine measures on invasive pest species.
What is it? (TIMP description)	Integrated management of mealybugs uses various approaches in the management of the pest and applied during pre-harvest and post-harvest stages. These approaches include cultural management, tolerant varieties and chemical control.
	Cultural practices • Maintain uncultivated edges within the farm to habor natural enemies • Till the land to expose the crawlers to the sun and predators • Inspect incoming seedlings for signs of mealybugs

	• Start with clean plant materials from certified sources such as KALRO- Thika (HRI). • Immediately dispose of heavily infested plants by burning. • Prune and hedge the trees to reduce overlapping of branches • Sanitize all equipment used in tree management and harvesting • Weed any possible host plants to reduce populations • Apply oil/sticky materials on the trunk to prevent crawlers from climbing the tree
	Biological Control • Management of avocado mealybug to prevent stress on the fruit trees during development and reproduction stage is paramount. Use of neem-based biological products prevent pollution of the environment and possible poisoning of consumers. • Use *Bacillus thuringiensis* at 0.49kg/acre to effective manage this pest. **Chemical management**: • Spray bio pesticides such as Abamectin 0.15 EC • Spray natural insecticides Spinosad at 2.45–73.5g/acre
Justification	Invasive mealybug pests have increased in most orchards across the country preventing potential yield of avocado fruit in most areas. 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.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Producers, Exporters, Agripreneurs
Approaches 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 avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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 and national governments to develop 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, Kiambu, Nyeri, Embu, Meru, Uasin Gishu, Nakuru, Bungoma, Trans Nzoia, Nandi, Narok, Bomet
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish avocado 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 upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • 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 can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB and KEBS to ensure pest control products sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs account for about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652 per acre in the third year after crop establishment, the first crop is harvested in the third year and

	returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Employment opportunities for youth as service providers e.g. in spraying with chemicals
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kirinyaga, Embu and Meru have adopted the management practice.
Application guidelines for users	Plantwise Knowledge Bank
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalr o.org Phone: 020- 2055038
Lead organization and scientists	KALRO: Njuguna J.K.; Otipa M.J.; Wasike, V.W.; Mwaura S.; Too A.; Gathambiri C.
Partner organizations	ICRAF, CABI, KOPPERT, Real IPM

2.7.4 Integrated management of Avocado thrips, *Frankliniella occidentalis* (Pergande)

2.7.4 TIMP Name	**Integrated management of Avocado thrips, *Frankliniella occidentalis* (Pergande)**
Category (i.e. technology, innovation or management practice)	Management practice

	 *A thrip on leaf tissue* *(Source: Muo Kasina, KALRO)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop loss due to infestation by thrips
What is it? (TIMP description)	Improved, high yielding and better fruit quality variety end up being attacked by varied thrips species. Use of systemic short duration insecticide application reduces stress and allow better fruit setting where suppression of the density occurs. http://ipm.ucanr.edu/PMG/PESTNOTES/pn7429.html Integrated management of thrips includes the use of various approaches in management of the pest applied during pre-harvest and postharvest stages. These approaches include: cultural management, biological and chemical control
	Cultural practices • Establish wind breakers around the farm to prevent thrips being 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 cowpea under the guava trees • Prune guava trees to allow light penetration into the canopy • Remove old plant debris and destroy by burning as they harbor thrips pupae **Biological control** • Hang yellow sticky traps 15cm above the foliage for trapping the thrips at 8 traps/acre • Use aluminum reflective mulch to keep away the thrips • Spray the underside of the leaves with a solution of neem-based products; Azadirachtin 0.3% like Neemark at100 ml/20 L, Achook, (20 ml/20 L), Nimbecidine (50-60 ml/20 L). Apply biological insecticide (e.g. Nembecidine) during fruit ripening stage to prevent thrips from ovipositing on the maturing fruit. Repeat the application of the insecticide weekly for three consecutive weeks to make sure all ripening stage is covered. Suspected infested fruits should be buried under soil to destroy emerging thrips.

	• Spray the underside of the leaves with a solution of *Beauveria bassiana* such as Beuvitech at rate 20 g/20 L water, early before large thrips populations build up **Chemical management**: • Spray Alpha-cypermethrin 100 g/L products like Alfatox 100Ec, 5- 10 ml/20 L, Tata Alpha 10EC (10 ml/20 L). Repeat spray after 7 days. • Spray Acetamiprid like Aceta 20SP. Acetak Top 70 WG (5-10 ml/20 L). Repeat spray after 7 days
Justification	An unquantified yield loss of avocado fruits is experienced in the production regions due to attack by thrips. Management of thrips reduces plant stress during dry spell and prevents reduction of photosynthetic rate on fruit trees. Yield potential of the avocado tree is restored after controlling damage by various thrips species.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Agripreneurs
Approaches 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 avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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 pest and disease management • Farmers/farmer groups to adopt the technologies • County and national governments to develop 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, Kiambu, Nyeri, Embu, Meru, Uasin Gishu, Nakuru, Bungoma, Trans Nzoia, Nandi, Narok, Bomet
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu,

	Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish avocado 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 upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • 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 upscaling	• Regulatory bodies e.g. PCPB, and KEBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willing to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities for youth as service providers e.g. in spraying with chemicals

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers in Murang'a, Kirinyaga, Embu and Meru have adopted the management practice.
Application guidelines for users	Plantwise Knowledge Bank
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Njuguna J.K.; Otipa M.J.; Wasike, V.W.; Mwaura S.; Too A.; Gathambiri C.
Partner organizations	ICRAF, CABI, KOPPERT, Real IPM

2.7.5 Integrated management of Avocado leafhoppers, *Empoasca dolichi and E. lybica*

2.7.5 TIMP Name	**Integrated management of Avocado leafhoppers, *Empoasca dolichi and E. lybica***
Category (i.e. technology, innovation or management practice)	Management practice  *Avocado leafhopper.* *(Source; H. Heya, KEPHIS)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop loss due to infestation by leafhoppers
What is it? (TIMP description)	Integrated management of leafhoppers includes the use of various approaches in management of the pest that are applied

	during pre-harvest and postharvest stages. Management of avocado plant hoppers prevent stress on the fruit trees during development and reproduction stage. The hoppers infestation occurs during dry period and cause major damage during flower setting. These approaches include: cultural management, tolerant varieties and chemical control **Cultural practices** • Ensure that sanitation and field hygiene practices are adhered to by collecting and disposing of infected fruits, leaves, and twigs • Collect fallen fruits and destroy by burying at least 40cm depth • Ensure that pruning is undertaken to remove infected twigs and also improve on air circulation • Ensure that the orchard is weeded and other agronomic practices are carried out **Biological Control** Use *Bacillus thuringiensis* at 0.49kg/acre to effectively manage the pest **Chemical management**: Spinosad-based insecticides are most effective and safe as they are highly biodegradable
Justification	Occurrence of invasive hoppers species have increased in most orchards across the country preventing potential yield of avocado fruit. Through farmer field and business schools and with the establishment of information platforms, forum for sharing and dissemination of information on use of the most suitable insecticide are enabled. Application of Spinosad products will secure higher yields of avocado fruits.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Agripreneurs
Approaches 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 avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Adoption of appropriate agronomic practices

	• 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 and national governments to develop 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, Kiambu, Nyeri, Embu, Meru, Uasin Gishu, Nakuru, Bungoma, Trans Nzoia, Nandi, Narok, Bomet
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish avocado 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 upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB, KEBS 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 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652 per acre in the third year after crop establishment, the first crop is harvested in the third year and

	returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	• Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Farmers in Murang'a, Kirinyaga, Embu and Meru have adopted the management practice.
Application guidelines for users	Plantwise Knowledge Bank
F: Status of TIMP readiness 1 = ready for up-scaling; 2 = requires validation; 3 = requires further research	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Njuguna J.K.; Otipa M.J.; Wasike, V.W.; Mwaura S.; Too A.; Gathambiri C.
Partner organizations	ICRAF, CABI, KOPPERT, Real IPM

2.7.6 Integrated Pest Management of Avocado Aphids, spirea aphid (*Aphis spiraecola*) and melon aphid (*Aphis gossypii*)

2.7.6 TIMP Name	**Integrated Pest Management of Avocado Aphids, spirea aphid (*Aphis spiraecola*) and melon aphid (*Aphis gossypii*)**
Category (i.e. technology, innovation or management practice)	Management practice

	 *Colony infested avocado leaf* *(Source: Too A., KALRO)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Crop loss due to infestation by Aphids
What is it? (TIMP description)	Management of avocado plant aphids to prevent stress on the fruit trees during development and reproduction stage. It involves the use of various effective environmentally safe approaches in controlling of the aphids. Insecticides sprays with horticultural soap will desiccate and suffocate the insects and horticultural oil will smoother the insects but these organic products should not be used when the weather is above 32°C as plant leaves can scotch or burn. Alternative products are the low toxicity, residual chemicals imidacloprid and acetamiprid. Application of some soap and agricultural oils aid in disrupting oviposition of aphids and life stage cohorts. Neem-based products disrupt developmental stages of aphids thus reducing the multiplication rates **Cultural practices** • Grow clean healthy plants that are able to withstand attack by aphids • Plant in a well prepared fertile field to promote crop vigour • Intercrop with onion, garlic, spider plant, coriander • Rotate with non-host crops e.g. maize, upland rice, sorghum, okra, sugarcane and sunflower to prevent population build up. Do not rotate with beans, cowpeas, lucerne, pigeon pea • Keep the fields free of weeds and alternative hosts such as wild mustards • Use chemicals cautiously to conserve natural enemies (e.g. flower bugs, lady bird beetles, praying mantis, hover flies, green lace wing, long horned grasshoppers and spiders **Biological Control** • Remove aphid affected twigs along with aphid colony at the early stages of growth and destroy by burning • Place yellow basins half-filled with soapy water near the affected plants to attract and trap the winged aphids

	• Apply neem products (e.g. neem oil 40 ml/20 L water) maximum 2 times per month. Start 15 days after transplanting reaching coverage of fruits and plants • Spray with soapy water solution (Mix 1 tablespoon of teepol with 4 litres of water, apply on the infested plants including the leaf undersides) **Chemical management**: • Lambda-cyhalothrin 2.5% W/V (10-15 mls/20 L) such as Karate • Spray with Azadirachtin 1% @ 3 ml/L or 5% @ 1 ml/L (like Achook 0.15% EC, Fortune AZA, Neemraj Super, Nembecidine EC, Ozoneem 1% EC • Spray with Deltamethrin based products such as Atom 2.5EC, Decis 2.5 EC etc at the rate of 10-15 mls/20 L of water
Justification	Presence of Avocado aphid species have increased in most orchards across the country preventing potential yield of avocado fruit. The use of different insecticide molecules, both of biological and soft-chemical natures, have ensured non resurgence of aphid populations in most orchards where aphid populations are kept below economic injury levels. Like most other pests aphids have natural enemies such as lady beetle larva, wasps, spiders and parasitic fungi. Therefore, improving diversity by planting wild flower strips in the orchard and hedge rows, will enhance the beneficial insects. By wrapping a smooth, slippery plastic band around the trunk or any sticky substance will also restrict the movement of the mobile pests. In case of heavy infestation it is possible to control by spraying a 1% soap solution in 1 % pure alcohol, with an application of paraffin oil (white oil) as a 3 % water emulsion or with a plant extract of neem or other botanicals
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Agripreneurs
Approaches used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - on-farm and on-station • Agricultural shows/exhibitions/field days • Training - 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 avocado varieties • A platform for interaction of avocado value chain stakeholders

	• Adoption of appropriate agronomic practices • Well-organized farmer groups and networks
Partners/stakeholders for scaling up and their roles	• KALRO to continually undertake research in integrated pest and disease management • KEPHIS to ensure seedling quality is maintained • PCPB to promote registration of crop health products for disease management • Farmers/farmer groups to adopt the technologies • County and national governments to develop 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, Kiambu, Nyeri, Embu, Meru, Uasin Gishu, Nakuru, Bungoma, Trans Nzoia, Nandi, Narok, Bomet
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenge in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides for guaranteed food safety • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • 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 upscaling	• Regulatory bodies e.g. PCPB, KEBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willingness 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 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	• Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year

	and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	• Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Farmers in Murang'a, Kirinyaga, Embu and Meru have adopted the management practice.
Application guidelines for users	Plantwise Knowledge Bank
F: Status of TIMP readiness (1 = ready for up-scaling; 2 = requires validation; 3 = requires further research)	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Njuguna J.K.; Otipa M.J.; Wasike V.W.; Mwaura S.; Too A.; Gathambiri C.
Partner organizations	ICRAF, CABI, KOPPERT, Real IPM

2.7.7 Integrated disease management (IDM) of avocado anthracnose (*Collectotrichum gleosporides*) and stem-end rot diseases (*Lasiodiplodia theobromae*)

2.7.7 TIMP Name	**Integrated disease management (IDM) of avocado anthracnose (*Collectotrichum gleosporides*) and stem-end rot diseases (*Lasiodiplodia theobromae*)**
Category (i.e. technology, innovation or management practice)	Management practice   *Anthracnose disease* *Stem-end*  *rot disease* (*source : A. A. Seif, ICIPE)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest fruit rots due to anthracnose and stem end-rot disease
What is it?(TIMP description)	Integrated anthracnose and stem-end-rot management encompasses use of various approaches in controlling of the diseases. They are applied during pre-harvest and postharvest stages. These approaches include: cultural management, adoption of tolerant varieties and chemical control **Pre-harvest management practices** **Cultural practices** • Ensure that sanitation and field hygiene practices are adhered to by collecting and disposing infected fruits, leaves and twigs • Ensure that pruning is undertaken to remove diseased twigs and also improve on air circulation • Ensure that the orchard is weeded and other agronomic practices are carried out • Using tolerant varieties: grow varieties that are less susceptible to the diseases **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. Copper based fungicides e.g. Cuprocaffaro WP Trifloxystrobin + Tebuconazole based fungicides e.g. Nativo 300 SC or Carbendazim based fungicides e.g. Rodazim SC can be used **Postharvest management** **Hot water treatment** Dip the fruits in warm water at 53ºC for 5-10min. Ensure that the heat treated fruits are handled carefully since they are susceptible to physical injury
Justification	Anthracnose and stem-end rot (SER) are the major postharvest diseases causing up to 60% postharvest losses and reduced shelf life in avocado 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, Agripreneurs
Approaches 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 avocado varieties • A platform for interaction of avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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 and national governments to develop enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	

Counties where already promoted if any	Nyeri, Kiambu, Kisii, Meru. Embu, Bungoma, Nakuru Uasin Gishu, Kiambu
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Avocado 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 upscaling if any	• Adoption of good agricultural practices by the producers is key in management of the diseases • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and upscaling	• Regulatory bodies e.g. PCPB and KEBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willingness to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information,

	technology and knowledge
Gender related opportunities	• Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	• Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Farmers in Murang'a, Nyeri, Kiambu, Kisii and Meru have adopted the management practice
Application guidelines for users	• Kimaru K. S, K. P Muchemi & J. W Mwangi | Manuel Tejada Moral (Reviewing editor) (2020) Effects of anthracnose disease on avocado production in Kenya,Cogent Food & Agriculture, 6:1, DOI:10.1080/23311932.2020.1799531 • Wanjiku, E. & Wanjohi, Waceke & Wanjala, Bramwel & Mbaka, J.. (2020). Identification and Pathogenicity of Fungal Pathogens Associated with Stem End Rots of Avocado Fruits in Kenya. International Journal of Microbiology. 2020. 1-8. 10.1155/2020/4063697. • Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI. • Aloo, J. 2005. Information on avocado and passion fruit in Rift Valley. Ministry of Agriculture. Personal communication.
F: Status of TIMP readiness **(**1= ready for up-scaling; 2 = requires validation; 3 = requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; 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.; Mutisya D.; Finyange P.
Partner organizations	ICRAF, CABI

2.7.8 Integrated management of Powdery Mildew (*Oidium perseae- americanae*)

2.7.8 TIMP Name	**Integrated management of Powdery Mildew (*Oidium perseae- americanae*)**
Category (i.e. technology, innovation or management practice)	Management practice

	 *Powdery Mildew in Avocado* *(Source: Plantdoctor.co.nz)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield losses occasioned by powdery infection
What is it?(TIMP description)	Integrated powdery mildew management comprises of various approaches applied in an integrated manner to break the disease cycle. These approaches include: cultural management and chemical control **Cultural practices** • Ensure that sanitation and field hygiene practices are adhered to by collecting and disposing infected fruits, leaves, and twigs. • Ensure that pruning is undertaken to remove diseased twigs and also improve on air circulation • Ensure that the orchard is weeded and other agronomic practices carried out **Chemical management** • Apply fungicides during new leaves flush, bud formation flowering are the most susceptible stages • Recommended fungicides: Sulphur based fungicides e.g. Thiovet jet WP Trifloxystrobin + Tebuconazole based fungicides e.g. Nativo 300 SC Carbendazim based fungicides e.g. Rodazim SC
Justification	Powdery mildew is a major challenge in avocado production which found in all the production areas. The disease attacks the leaves, flowers and twigs but is most destructive on the flowers causing drying up and abortion. This could led to total abscission of the bloom and over 70% yield losses can occur if the disease is not controlled
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, exporters, agripreneurs
Approaches 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 avocado varieties • Avail platform for interaction of Avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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 and national governments to develop 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, Kirinyaga, Kiambu.
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• 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 upscaling 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 that can be facilitated through innovation platforms • Adoption of good agricultural practices by the producers is key in management of the diseases • 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 and KEBS to ensure fungicides sold to farmers are genuine and of high quality. • Producers willingness to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
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	1. Njuguna K. J., Muriuki S.J.N., Watani G., Wanjala S. (2019). Avocado Manual, KALRO HRI 2. Lusike A. Wasilwa, Joseph K. Njuguna, Evelyn N. Okoko and Grace W. Watani. Status of avocado production in Kenya. 3. Aloo, J. 2005. Information on avocado and passion fruit in Rift Valley Province. Ministry of Agriculture. Personal communication.
F: Status of TIMP readiness (1 = ready for up-scaling;	Ready for upscaling

2 = requires validation; 3 = requires further research**)**	
G. Contacts	
Contacts	Institute Director, KALRO-Thika; 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.; Mutisya D.; Finyange P.
Partner organizations	ICRAF, CABI

2.7.9 Integrated management of Avocado scab (*Sphaceloma perseae*)

2.7.9 TIMP Name	**Integrated management of Avocado scab (*Sphaceloma perseae*)**
Category (i.e. technology, innovation or management practice)	Management practice  *Scab disease in Avocado* *(Source: Caesar Calderon)*
A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield losses due to infection by scab disease
What is it? (TIMP description)	Integrated scab disease management encompasses the use of cultural management practices, deployment of tolerant varieties and chemical control in the management of scab disease in Avocado **Cultural practices** • Ensure that sanitation and field hygiene practices are adhered to by collecting and disposing infected fruits, leaves, and twigs • Ensure that pruning is undertaken to remove diseased twigs that also improves on air circulation • Ensure that 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 Copper based fungicides e.g. Demildex WP Trifloxystrobin + Tebuconazole based fungicides e.g. Nativo 300 SC Carbendazim based fungicides e.g. Rodazim SC
Justification	Avocado scab disease may cause up to 90% yield losses if not 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, Agripreneurs
Approaches 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 Avocado varieties • Avail platform for interaction of Avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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 and national governments to develop enabling policies and create awareness. • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	

Counties where already promoted i f any	Murang'a, Embu, Machakos,Makueni, Kwale, Kilifi
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Avocado innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides • Promote establishment of farmer producer and marketing groups
Lessons learned in upscaling if any	• Establish avocado innovation platforms • Partnership is important in technology dissemination and adoption that 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 upscaling	• Regulatory bodies e.g. PCPB and KEBS to ensure fungicides genuine and high quality pesticides are available. • Producers willingness to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information,

	technology and knowledge
Gender-related opportunities	• Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
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	CAB International (2005). Crop Protection Compendium, 2005 edition. Wallingford, UK www.cabi.org
F: Status of TIMP readiness **(**1= ready for up-scaling; 2= requires validation; 3=requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; 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.; Mutisya D.; Too A.; Finyange P.
Partner organizations	ICRAF, CABI

2.7.10 Integrated management of Algal (*Cephaleuros spp*) spots in Avocado

2.7.10 TIMP Name	**Integrated management of Algal (*Cephaleuros spp*) spots in Avocado**
Category (i.e. technology, innovation or management practice)	Management practice  *Avocado Algal Spots* *(source: M Otipa and S. Mwaura, KALRO)*

A: Description of the technology, innovation or management practice	
Problem to be addressed	Yield losses occasioned by algal spots infection in avocado
What is it? (TIMP description)	Integrated Algal spots management comprises of various approaches applied in an integrated manner to break the disease cycle. These approaches include: cultural management and chemical control. Algal spots are diseases of plant foliage caused by one or more species of the plant-parasitic algal genus, *Cephaleuros* **Cultural practices** • Ensure that sanitation and field hygiene practices are adhered to by collecting and disposing infected fruits, leaves, and twigs. • Ensure that pruning is undertaken to remove diseased twigs and improve air circulation • Ensure that the orchard is weeded and other agronomic practices carried out **Chemical management** Apply Copper based fungicides
Justification	The algal spots reduce photosynthetic capacity of the crop, induces leaf fall, dieback of branches or distortion of fruits thus causing reduced returns to the farmers
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Agripreneurs
Approaches 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 Avocado varieties • Avail platform for interaction of Avocado value chain stakeholders • Adoption of appropriate agronomic practices • 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 and national governments to develop 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 upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Avocado innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides • Dissemination of agronomic practices
Lessons learned in upscaling if any	• Establish Avocado 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 upscaling	• Regulatory bodies e.g. PCPB and KEBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willingness to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs
Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores

	• Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
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	CABI Crop Protection Compendium. (2010). *Persea americana* datasheet. Available at: http://www.cabi.org/cpc/datasheet/39380.
F: Status of TIMP readiness **(**1 = ready for up-scaling; 2 = requires validation; 3 = requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; 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.; Mutisya D.; Finyange P.; Too A.
Partner organizations	ICRAF, CABI

2.7.11 Integrated management of Avocado Sunblotch (*Sunblotch viroid*)

2.7.11 TIMP Name	**Integrated management of Avocado Sunblotch (*Sunblotch viroid*)**
Category (i.e. technology, innovation or management practice)	Management practice  *Avocado Sun Blotch* *(Source: ucancr.edu,sciencedirect.com)*
A: Description of the technology, innovation or management practice	

Problem tobe addressed	Avocado sunblotch is a disease caused by Avocado sunblotch viroid (ASBVd). Symptoms of avocado sunblotch may include discolored and depressed stem streaks, grooves on older branches, lesions and discoloration of the fruit, and varied foliar symptoms. Some infected trees may remain symptomless
What is it? (TIMP description)	Integrated sunblotch management comprises of various approaches applied in an integrated manner to break the disease cycle. Careful propagation of nursery stocks to eliminate viroid will greatly reduce sunblotch to a relatively minor disease. Monitoring and management is required in nurseries and established groves. Look for disease and disease-promoting conditions regularly throughout the grove.
	Cultural practices • Carefully select disease-free scions and seed sources • Use stringent sanitation and frequent disinfection to avoid spreading pathogens • Periodically, confirm that propagation sources are disease-free (indexing) by grafting propagative source material to young disease free seedlings and observing leaves and twigs for sunblotch symptoms, or by performing a genetic test. In the orchard, plant only indexed nursery stock registered as disease-free. Promptly remove symptomatic trees from the grove and chemically kill the stumps
Justification	Sunblotch symptoms are variable. However, the most common in fruits are irregular sunken areas of white, yellow or reddish color. On severely affected fruits, the sunken areas may become necrotic leading to low marketability
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers, Exporters, Agripreneurs
Approaches 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 Avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Adoption of appropriate agronomic practices

	• 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 and national governments to develop enabling policies and create awareness • Financial institutions to provide credit facilitators
C: Current situation and future scaling up	
Counties where already promoted i f any	Embu, Nyeri, Embu, Nyeri and Kiambu.
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge by farmers on integrated pest management • Limited number of farmer groups • Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for Addressing the challenges	• Establish avocado innovation platforms • Dissemination of integrated pest management practices and safe use of pesticides • Dissemination of agronomic practices
Lessons learned in upscaling if any	• Establish avocado innovation platforms • Partnership is important in technology dissemination and adoption that 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 upscaling	• Regulatory bodies e.g. PCPB and KEBS to ensure fungicides sold to farmers are genuine and of high quality • Producers willingness to adopt the disease management practices • Producers organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 6,200/acre on average in the first three years (establishment of crop). Labour and inputs represent about 7.7% of the total variable costs

Estimated returns	Gross margin KES 48,652/acre in the third year after crop establishment, the first crop is harvested in the third year and returns increase as the number of fruits increase in subsequent years
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Avocado cultivation • Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying • Women and youth may have less access to labour • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	Employment opportunities for youth as service providers e.g. chemical spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying • VMGs have less access to information, technology and knowledge • VMGs may have less access to labour
VMG related opportunities	Employment opportunities for youth and those recovering from drugs as service providers especially during spraying
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	CABI Crop Protection Compendium. (2010). *Persea americana* datasheet. Available at: http://www.cabi.org/cpc/datasheet/39380.
F: Status of TIMP readiness **(**1 = ready for up-scaling; 2 = requires validation; 3 = requires further research**)**	Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO-Thika; 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.; Mutisya D.; Too A.; Finyange P.
Partner organizations	ICRAF, CABI

2.7.12 Avocado Integrated Weed Management

2.7.12 TIMP Name	Avocado Integrated Weed Management
Crop management practices	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Reduced yield and profitability of avocado due to competition from different annual and perennial weed species and poor weed management in the cropping systems. Some key weed grass species including Crab sanguinalis (*Digitaria spp.*), goose grass (*Eleusine indica*), Craws feets (D*actyloctenium aegyptium), Sateria spp.* Palmer amaranths (*Amaranthus palmeri*), Red pigweed (*A. retroflexus*) and Sedges including Yellow nutsedge (*Cyperus esculentus*) and Purple nutsedge (*Cyperus rotundus*) are a challenge in avocado growing fields or regions due to their morphological and phenological characteristics. Competition occurs at four levels: 1) intraspecific competition between avocado plants, 2) interspecific competition between avocado and weed species, 3) interspecific competition between weed species, and 4) intra specific competition between same weed species. These weeds compete with the plants for soil nutrients, moisture, space and sunlight
	 *Mulching with grass clips in avocado to control weeds (Source: Hottensiah Mwangi, KALRO)*
What is it? (TIMP description)	• Integrated Weed Management (IWM) is the use of two or more appropriate approaches including preventive, planting in a weed free prepared land, use of mulch (biodegradable or synthetic), cultural, rotation, intercropping and chemical control based on case specific weed condition of the field, resources, accessibility, and type of landscape • Cultural approach includes transplanting rather than direct planting, proper fertilization, irrigation, use of cover crops and plastic mulch to reduce weed populations. Physical control is the removal of weeds manually or by mechanical means, such as hand weeding or mowing. In manual method, weeds are removed frequently to ensure area surrounding the tree is weed free as possible. Mow weeds between the rows should be done repeatedly in a year to prevent serious competition with young trees. In chemical control, recommended herbicides are applied following the manufacturer's instructions. The weed composition needs

	to be identified and the data used to timely implement the best management approach. The first step is to monitor the fields and maintain records of the weeds occurring in each field. This is followed by identification of the species and their likely area of appearance. Proper identification of species will guide on management approach. However, one method can be effective in managing some species and not others. Thus, it is recommendable to use two or more approaches depending on weeds species, density and stage of growth for effective management and a profitable avocado crop
	 *Weed species in an avocado orchard at flowering stage. (Source: Hottensiah Mwangi, KALRO)*
Justification	Avocadoes are vulnerable to weed invasion. Clipping vine weeds such as cats claw creeper and madeira can quickly spread and smoother even killing large trees. Avocadoes are vulnerable to weed invasion, graze and wild fires. Other weeds such as lantana weeds are a challenge due to limited knowledge on weed biology and management strategies. Whereas manual weeding can be effective for managing some weed species, the practice is time consuming and labour intensive. It can also be ineffective especially because specific types of weeds such as *Commelina benghalensis* and *Portulaca oleraceae* get apparently disseminated through cuttings and rejuvenates when weeding is done under wet conditions. Therefore, there is need to apply more than one approach to manage the biodiversity of weeds. Judicious use of herbicides integrated with cultural methods gives a promising IWM option for weed control in avocado cropping systems
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension workers, Agrodealers, Agripreneurs
Approaches 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 IWM in avocado varieties • Avail platform for interaction of avocado value chain stakeholders to promote and train on integrated weed management (IWM). • Address environmental and safety concerns related to the use of herbicides • Accompany the promotion with demonstrations and field days with farmers groups and stakeholders on the effectiveness of the various weed management options using FFBS approach • Train stakeholders on the biology of weeds and weed dynamics in cropping systems • Training farmers on conservation of biodiversity that include preservation of pollinators for increased productivity of weed control management • Train users on appropriate use of herbicide and safe use
Partners/stakeholders for scaling up and their respective roles.	Agrochemical companies, Agrodealers, KALRO, County extension staffs, CBO, NGOs, Agripreneurs
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Kirinyaga, Nandi and Muranga
Counties where TIMPs will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of agronomic practices • Labour intensity • High cost of herbicides • Inadequate knowledge and information on types of herbicides to use, how and when to use and their persistence in the soil • Myths on appropriateness of using herbicides
Suggestion for addressing the challenges	• Establish avocado innovation platforms, promotion of the technology/ product in the suitable areas conducting demonstrations and field days and involvement of the stakeholder e.g. agro-chemical companies and agro-dealers • Develop and disseminate information to various stakeholders. • Training on integrated approaches using available methods, including appropriate herbicides for avocado

	• Persistence of avocadoes in different soil environment that can affect follow up intercrop or cover in the first five years of avocado establishment • Safe use of herbicides
Lesson learned in upscaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Integrated approaches of weed management are more effective than use of one control method and is environmentally friendly • Continuous use of herbicide is an environmental, health and social hazard • Consumers concerns of herbicide residues in the soil and odor absorption by nuts needs attention • Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ IWM • Availability of market is essential • Partnership is important in technology dissemination and adoption and can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up-scaling	• Train stakeholders to understand the working of an integrated weed management program • Address the environmental and social concerns related to use of herbicides • Functional agrodealer network to supply the products when required by the farmers • Have a safety plan when using herbicides
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities such as weeding hence this may increase their work burden • Women and youth have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women in weeding and the youths in spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, and quality Avocado seedlings • 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 those recovering from drugs in weeding and spraying
E: Case studies/profiles of success stories	
Success stories	Kenya smallholder farmers
Application guidelines for users	Scholarspace.manoa.hawaii.edu/bitstream/10125/15280/1/8-121pdf
F: Status of TIMP Readiness (1 = Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Nyaga A.
Partner organizations	KALRO , NGOs, CBOs, County Governments, KEPHIS

2.7.13 Avocado Intercropping System

2.7.13 TIMP Name	**Avocado Intercropping System**
Categories (i.e. technology innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addresses	 *Young transplanted Avocado surrounded by weeds, Amaranthas spp.* *(Source: Hottensiah Mwangi, KALRO)* Weed competition is a problem in avocado cropping system. Suitable crops should be used for intercropping to provide income in the years before profitability of avocados. This should be done intelligently to profit trees through weed control and soil fertility. Farmers inter-cropping avocado with other crops such as corn, papaya, shallow rooted vegetables and passion fruit to reduce weeding and boost investment returns in young orchards. Intercropping to control weeds requires

	specific spacing and the right choice of crops depending on growth habit of the intercrop This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to avocado intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition, knowledge most farmers lack
What is it? (TIMP description)	Innovative Avocado Intercropping System is the growing of two or more crops in a field at the same time, as a tool to enhance agricultural production and to obtain efficient land use by reducing weed area. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. Appropriate intercropping systems are strip or row patterns in avocado Appropriate crops for intercropping in between rows of avocado may include planting shallow rooted vegetables (onions, parsley), cereals (maize), legumes (beans), passion fruit and coffee. Innovative intercropping systems should involve proper arrangement to reduce weeds
Justification	Intercrops in middle rows done prudently provide weed control between rows and profit avocados through soil health improvement. Suitable intercrops can provide income during the years before profitability of avocados. Innovative intercropping systems can help farmers achieve the desired productivity and profitability while at the same time diversifying the cropping system and adapting to climate change. Avocado does well when intercropped with legumes to mitigate the risk of total crop failure due to drought. Intercropping has important advantages in regard to efficient land use. It can significantly increase total productivity as compared to monocropping, thanks to better utilization of water, nutrients and solar energy. Crops in these systems use available resources more efficiently due to different rooting and canopy properties; but they should not shade or disturb root system. Therefore, this is one of the most dependable ways to sustain avocado production in light of prevailing climate change.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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  *Dissemination of technologies to value chain stakeholders*
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release intercropping system • Avail platform for interaction of value chain stakeholders • Conduct demonstrations and field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, private sectors e.g. seed company and seed dealers, research organizations (KALRO, Egerton University, UoN)
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Murang'a, Kirinyaga and Nandi
Counties where TIMPs will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the agronomic practices • Inadequate training and limited extension staff
Suggestion for addressing the challenges	• Establish avocado innovation platforms • Facilitate training of county extension staff • Conduct demonstrations and field days
Lesson learned in upscaling if any	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Intercropping systems are knowledge intensive and should not shade, crowd or compete seriously for soil and water. Such a change calls for intensive training and

	demonstration for farmers to familiarize with the innovation so as to benefit • Creation of awareness through demonstrations and farmer field days helps in adoption of the innovation avocado intercropping • Availability of market is essential • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the innovative intercropping systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Women have less access to information, technology and knowledge • Women and youth have limited access to the equipment used • Women have less access to land for use • Women and youth have limited access to education, training and extension services • Men dominant most decisions at the household and community levels
Gender related opportunities	• Intercropping offers good opportunities to both men and women to grow diverse crops for economic gains • Intercropping offers enhanced biodiversity benefits
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 related opportunities	• Intercropping places emphasis on the importance of using available land space to grow diverse food crops, increase biodiversity and pest management making the practice economically viable for the VMGs • System diversification and yield stability will increase food availability leading to food and nutrition security for the VMGs
E: Case studies/profiles of success stories	
Success stories	Kenya smallholder farmers

Application guidelines for users	Scholarspace.manoa.hawaii.edu/bitstream/10125/15280/1/8-121pdf
F: Status of TIMP Readiness (1= Ready for upscaling; 2 =. Requires validation; 3= Requires further research)	Require validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	County extension staff, farmer groups. CBOs, NGOs

2.7.14 Cover cropping for Avocado weed management

2.7.14 TIMP Name	**Cover cropping for Avocado weed management**
Categories (i.e. technology innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addresses	Different annual grass weeds and perennial weed species, and poor weed management lead to yield losses and lack of profitability in avocado cropping systems especially at nursery stage. Some key weed grass species including Crab sanguinalis (*Digitaria spp.*), goose grass (*Eleusine indica*), Crawsfoot (D*actyloctenium aegyptium)*, *Sateria spp., double thorn* (*Oxygonum sinuatum*) Palmer amaranths (*Amaranthus palmeri*), Red pigweed (*A. retroflexus*) and Sedges including Yellow nutsedge (*Cyperus esculentus*), and Purple nutsedge (*Cyperus rotundus*) are more a challenge in avocado growing fields or regions where they have succeeded because of their biological characteristics
	 *Weeds in a young avocado orchard* *(Source: Hottensiah Mwangi, KALRO)*

What is it? (TIMP description)	This is a technology where selected crops are grown to produce biomass/canopy to cover soil. This may be live cover or dead crop residue. After cover crop has produced biomass, it may later be killed by rolling them down or desiccated with a post emergence herbicide to form a soil cover. This cover acts as a physical barrier cutting off light to stop germinating weed seeds from emerging. Large amounts of cover crop biomass suppress weeds in the subsequent season and duration of effective suppression depends on type of cover crop used and amounts of biomass used
Justification	Cover cropping with appropriate variety of cover crop (technology) works well with avocado in no till system. Large amounts of biomass developed by cover crops suppress weeds in subsequent season. Rolled down cover crop straws will reduce weed emergence by forming a physical barrier. Also the cover crop such as black oats may produce allellochemicals that inhibit small seeded weeds germination and emergence. Physical chemical suppression may last a month depending on amount of biomass. Cover crops may also be left to conserve moisture and modify soil temperatures where necessary as an added benefit. Different crops particularly legumes and cereals could be good cover crops
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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 cover cropping in avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Conduct demonstrations and the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company and seed dealers, Research organizations (KALRO, County staff)
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a

Counties where TIMPs will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the agronomic practice • Labour intensity in planting and weeding • Inadequate training and limited extension staff
Suggestion for addressing the challenges	• Establish avocado innovation platforms • Information dissemination on the technology • Promotion of the technology in the suitable areas • Facilitation of training of county extension staffs • Contact demonstrations and field days
Lesson learned in upscaling 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 technology • Availability of market is essential • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms • Cover crop technology is knowledge intensive. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology use to gain its benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination adoption and scaling up	• Cover cropping system can result in reduced labour for women who mostly perform weeding • Women and youths have less access to technology knowledge and information • Women have less access to farm implements
Gender related opportunities	• Opportunities exist for women to perform the operation • Diversity and yield stability are a major win for the various gender categories
VMG issues and concerns in development, dissemination, adoption and scaling up	• Cover cropping system can result in reduced labour for the VMGs • VMGs may have less access to specialized implements required for cover cropping systems
VMG related opportunities	• Cover cropping system can result in reduced labour for the VMGs

	• System diversification and yield stability will increase food availability leading to food and nutrition security for the VMGs • Improved income from production and marketing of avocado and other cover crops
E: Case studies/profiles of success stories	
Success stories	Farmers in Machakos and Makueni have adopted the management practice
Application guidelines for users	Http://dx.doi.org/10.1016/j.eja.2015.05.001.
F: Status of TIMP Readiness (1 = Ready for upscaling; 2 = Requires validation; 3 =Requires further research)	Require validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	County extension staff, Farmer groups, CBOs, NGOs

2.7.15 Mulching in weeds control

2.7.15 TIMP name	**Mulching in weeds control**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weed competition for soil nutrients, moisture and unfavorable soil temperatures.  *Various annual weeds and grasses cover in Avocado field* *(Source: Hottensiah Mwangi, KALRO)*
What is it? (TIMP description)	• The practice of covering the soil/ground with natural or synthetic materials. Mulches can effectively control weeds and weed seeds germinating near or at the soil surface. There are two types of mulches: biodegradable or natural mulches. Biodegradable include straw, dead leaves and compost that make more favourable conditions for avocado growth,

	development and efficient production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can also be used • Organic mulches suppress weeds, retain moisture in the soil, keep the soil cool, help improve soil fertility (as the mulches decompose providing calcium, boron, zinc, nitrogen, potassium, and trace elements) and improves microclimate hence increasing biodiversity • Synthetic mulches will solarize soils, control weeds and weed seeds germination, retain soil moisture and control diseases. Inspect and pull out emerging weeds timely
Justification	Weeds can easily choke and kill young seedlings. In sand box or seed bends, use of black polythene prevents light from reaching the young weeds and prevent germination. Organic mulching (straws or dry leaves) on rows adds benefits other than minimizing weeds infestation. It facilitates retention of soil moisture and helps in control of temperature fluctuations, thus improving physical, chemical and biological properties of soil by adding nutrients to the soil that ultimately enhances the growth and yield of crops. It also improves soil structure both directly by preventing raindrop impact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
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 mulching technology in avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Availability of plant or crop residues for organic mulches • Size of the land. • Competing uses of crop residues. • Type of the crop residues • Cost of materials • Disposal of material after use
Partners/stakeholders for scaling up and their roles	• County government extension services; Provide link with farmers

	• Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted	Meru, Kirinyaga, Nandi and Muranga
Current extent of reach	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the agronomic practice • Labour intensity and availability of mulching materials • Lack of enough plant and crop residues due to competing uses of organic mulches • Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches • Awareness of small tears and rips which will allow weeds emergence through plastic mulches. Purple and yellow nutsedge may penetrate mulches as early as six days after transplant in plastic mulches
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Crop diversification to increase availability of organic mulches. • Establish and follow integrated weed management control program • Monitor for any tears /rips and pull out any weeds without allowing them to take over • Adapt alternative mulching materials like high absorbance polymers
Lessons learned	• 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 innovations • Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ IWM • Availability of market is essential • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms • Adaption of alternative mulching technologies in addition to use of organic materials like straws, dry leaves and dry grass
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict for those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up • Since the activity is labour intensive, it may increase the labour burden for the various gender category especially women who are already overburdened • It will reduce women weeding time that can be used to performing other productive activities
Gender related opportunities	• It can offer employment opportunities for the youths • Mulching reduces weeds thus women who perform most of the weeding activities will be relieved to perform other equally demanding economic activities
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is can be labour intensive for VMGs, hence its adoption and scaling up may be a challenge
VMG related opportunities	Mulch is locally available on-farm and thus has very low costs, implying that all including VMGs can take advantage of the practice.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology
Application guidelines for users	• Plant clean avocado seeds in clean seed bed • Apply mulch around the avocado trees **Mulch management** Hand pull or kill weeds that grow out of the mulch
F: Status of TIMP readiness (1 = Ready for up-scaling; 2 = Requires validation; 3 =Requires further research	Ready for up-scaling
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	County governments, Public-Private-Partnerships

2.7.16 Herbicide (chemical) weed control

2.7.16 TIMP Name	Herbicide (chemical) weed control
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Competition from weeds prevents avocado from getting nutrients, soil moisture and space resulting in weak and stunted growth that ultimately leads to reduced yields. This poses a problem especially to young avocado. Amount of damage on young avocado depends on weed density, diversity, stage of growth and the environment. Grass weeds include crab sanguinalis (*Digitaria sanguinalis*), and goose grass (*Eleusine indica*). Broadleaved weeds including Palmer amaranths (*A. palmer*), Red pigweed *(A. retroflexus*), Purple nutsedge (*Cyperus rotundus*) and Yellow nutsedge (*C. Esculentus)* are more challenging. The weed problem is aggravated by wrong timing and poor management activities
What is it? (TIMP description)	Chemical weed control refers to any technique that involves the application of herbicide to weeds or soil to control the germination and growth of the weeds. Herbicide weed control is a technology that requires intensive knowledge on herbicides mode of action, selective for avocado, conditions necessary for effective application, type of soil, when to apply and how the application is done Use only recommended herbicides listed by Pesticide Control Products Board as per label
Justification	 *Wide spectrum weed biodiversity and high weed density* The biodiversity of weeds compete with avocado fruit trees for water and nutrients in the soil. Too many weeds can lead to small fruits or stressed avocado plants. It is advisable to use herbicide marked as safe to use with fruit trees

	 *Herbicide application before planting the orchard (Source: Hottensiah Mwangi, KALRO)* Appropriate use of herbicides reduces drudgery and allows timely weed control. 2, 4-D can be used in before planting the orchard or use a hood in avocado orchards for control of *Commelina benghalensis, P. clandestinum, P. purpurescens, C. dactylon.* Spray at low pressure, three times at 15 day interval on young sacculents weeds Post emergence herbicides such as glyphosate and paraquat are applied to control weeds in row middles using a hood or using a wick to avoid crop injury. Proper calibration of sprayer is critical to maintain correct sprayer pressure, flow rate from each nozzle and tractor or walking speed. Avoid spraying bark or foliage of young avocado plants Do not spray herbicides on orchards with fruits as they may be contaminated with herbicides
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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	On-farm experimentation and large plot effect demonstrations
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release herbicide weed control in avocado • A platform for interaction of avocado value chain stakeholders • Capacity building and training on appropriate and safe use of herbicide for all users because incorrect application will lead to injury in avocado, reduced yields, decreased fruits, reduced plant vigour, increased susceptibility to diseases and pest and sometimes can result in plant death • Weed killers can also be dangerous to fruit trees leading to

	herbicide residue
Partners/stakeholders for scaling up and their respective roles	• Public (MoALD) and private partners • Chemical companies for back stopping • Farmer Input Promotion (FIPs) for promotion • Farmer Groups for activity implementation and promotion. • Service provider agencies e.g. Micro-finance agencies and banks for credit provision • Agro-vets for input supply • Processors and manufacturers to create market for produce, • Aggregators e.g. Community Action for Rural Development (CARD) for economy of scale sales and marketing • NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc
C: Current situation and future scaling up	
Counties where already promoted if any	All counties growing fruits
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Current extent of reach	Validation of these herbicides need to be done under different agroecological zones and soils before recommendations are given to the farmers.
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders. • Low use of agronomic practice • Limited knowledge, information and low literacy levels among the farmers or sprayers to read and interpret label instructions • Capacity building is required to impart knowledge and skills in safe use and application of herbicides • Farmers need to understand the proper use and application of herbicides to avoid buying inappropriate herbicides and minimize health, environmental and social hazards
Recommendations for addressing the challenges	• Establish avocado innovation platforms • Train advisory and service providers as ToTs on appropriate use of herbicides so as to help in reaching the farmers with the right information. Herbicides, like all chemicals, have to be used with care to avoid environmental, health and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on safe use of herbicides
Lessons learned	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the technology such as chemical weed control

	• Consumers concerns of herbicide residues in the soil and subsequent crops needs attention • Availability of Avocado market is essential • Partnership is important in technology dissemination and adoption which can be facilitated through innovation platforms • Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of herbicides is vital
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Herbicide use is cheaper than manual weed control because it requires less labour and achieves timely weed management
Estimated returns	Not yet estimated
Gender issues and concerns in development,	• Men and youth perform most of the spraying activities hence this may reduce the women work burden • Women and youth have limited access to education, training and extension services
dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels
Gender related opportunities	• Employment opportunities exist for the youths in spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 • Low adoption by VMGs due to lack of awareness
VMG related opportunities	• Opportunities exist for those recovering from drugs in spraying • Use of herbicides will improve weed management leading to increased productivity, increased availability of avocado for consumption which will improve food security hence improved
E: Case studies/profiles of success stories	
Success stories	Large scale farms in Kenya
Application guidelines for users	Herbicides. North Calorina State Extension <Https//content.ces.ncsu.edu>
F: Status of TIMP Readiness **(**1=Ready for up- scaling; 2=Requires validation; 3=Requires Research **)**	Requires research and validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org

	Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD in Counties, Chemical companies

2.7.17 Rapid response to invasive weed species (RRIS)

2.7.17 TIMP Name	**Rapid response to invasive weed species (RRIS)**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	 *Invasive weed species dodders (Cuscuta campestris) on a tree* • High incidence of invasive weed species dodders (*Cuscuta campestris*) • Ineffective, inefficient and unsustainable methods used to control invasive species • Limited awareness and knowledge on invasive weeds species.
What is it? (TIMP description)	• This is an early detection and rapid response precise method where many technologies, innovations or management practices of weed control are applied depending on the type of weed species and severity of weed pressure. Stakeholders are sensitized on weed impact and consistent follow up is done. Preventative, early detection, intensive repetitive weeding, application of herbicide (basal or bark painting or cut stump or re-growths of weeds can be used to control weeds before planting (post emergence herbicides). In addition, post emergence is applied on the actively growing weeds • Under non selective, broad spectrum, all herbicides are applied as recommended in the manufacturers label, and all instruction followed. directed or guarded with a hood to avoid harming the crop, mostly used in zero and minimum tillage

	• Spot spray application/ Boom application uses low rates of glyphosate for seedset suppression
Justification	In order to handle the complex invasive weed species problems in the region, a holistic line of action with multi-disciplinary approaches is used to bring together members of Invasive Weeds Technical Working group and other people who shared a common goal with CABI Global programme on Action on Invasive species (AoI). It focuses on strengthening national systems to better prevent, eradicate, control and manage Invasive Species. Macadamia is an important crop for food and nutrition security; and, income generation in Kenya.
Region promoted	All counties where weeds invasive weeds pose a risk.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Agripreneurs
Approaches 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	• Sustained demand for effective weed control methods • Favorable climatic conditions for Avocado production • Collaboration between all partners
Partners/stakeholders for scaling up and their roles	• Conduct trials and management of parasitic invasive species in hotspots; • County governments, extension staff, farmers' groups/CBOs and NGOs to implement.
C: Current situation and future scaling up	
Counties where already promoted if any	All counties growing fruits
Counties where TIMP will be upscaled	All avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited knowledge on weed biology • Limited personnel resource
Suggestions for addressing the challenges	• Create awareness on invasive weed species. • Share knowledge of weeds ecology and biology. • Training on weeds identification. • Training and demonstrate on mechanical hand control and disposal. • Economic analysis to convince growers on cost effectiveness

Lessons learned in up- scaling, if any	The current mindset and dependence on manual weeding to produce healthy avocado needs to be addressed.
Social, environmental, policy and market conditions necessary for development and up-scaling.	• Favorable climatic conditions for avocado production • Sustained market demand for high quality avocado nuts.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the weeding activities • Women have less access to information, technology and knowledge • Women and youth have limited access to education, training and extension services
Gender related opportunities	Opportunities exist for women employment in mechanical weeding
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 Avocado seedings • 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 to lack of awareness
VMG related opportunities	Opportunities exist for youths employment in mechanical weeding
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Research work done on IWM in weed control in Avocado at KALRO- Kabete • Invasive spp. work in Michigan misin.msu.edu. weedsmart.org.; Southwest.desert.flora
Application guidelines for users	Guidelines are yet to be developed
F: **status of TIMP Readiness** (1=Ready for up-scaling; 2=Requires validation; 3=Requires further research)	Requires validation and up-scaling
F: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD, County governments

2.7.18 Solarization bed for weed control

2.7.18 TIMP Name	Solarization bed for weeb control
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
	 *Diversity of weed species (grasses, broadleaved, annuals and perennials) that emerge to compete with avocado seedling for available nutrients, moisture and space* *(Source: Hottensiah Mwangi, KALRO)*
Problem addressed	Competition from weeds in seed beds can weaken and cause stunted growth of avocado seedlings. Weeds pose a problem 40-70 days after emergence being the critical period of weed management in young avocado. This depends on weed density, diversity, stage of weed growth and environment. The grass weeds include crab sanguinalis (*Digitria sanguinalis*), Sudan grass (*Sorghum halepense*), goose grass (*Eleusine indica*) and *Echinocloa colona* while broadleaved weeds include Palmer amaranths (*A. palmeri*), Red pigweed (*A. retroflexus*) and C. arvense L.), (*Chenopodium album* L.), (*Rumex crispus* L.) and *Portulaca oleraceae*. Purple nutsedge (*Cyperus rotundus*) and Yellow nutsedge (*C. Esculentus)* are more challenging to manage.
What is it? (TIMP description)	Solarization is a method where you use transparent polythene films to increase soil temperatures by 10^0C or more than atmospheric so as to kill weed seeds and seedlings. The basic phenomena is to build up lethally high temperatures in top soil where most dormant and viable seeds are present. The mechanism is mainly breaking dormancy of weed seeds, solar scotching of emerged weed seedlings and direct killing of weed seeds by heat. The strategy increases soil temperature by 8-12^{o}C over non mulched soil. Additionally, rhizomes of perennial weeds may be killed if not deeply buried. Effectiveness is species specific and depends on length of period of heating.
Justification	Solarization for two consecutive years is successful in controlling perennial weeds such as sedges. Solarization with 0.05mm polythene sheets for 40 days is more effective in

	controlling weeds and takes shorter duration than the use of 0.01mm polythene. This is a good ecological and environmentally friendly method that is sustainable for small scale seedling producers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - on-farm and on-station • Agricultural shows/exhibitions/field days • Training - 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	On-farm experimentation and plot demonstrations
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release solarization bed technology weed control in avocado varieties • Avail platform for interaction of avocado value chain stakeholders • Develop best agronomic practice for avocado • Capacity building and training on use of polythene and solar power
Partners/stakeholders for scaling up and their respective roles	• Public (MoALD) and private extension partners • Chemical companies for back stopping • FIPs (Farmer Input Promotion) for promotion. • Farmer groups for activity implementation and promotion. • Service provider agencies e.g. micro-finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. Community Action for Rural Development (CARD) for economy of scale sales and marketing, and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Counties where already promoted if any	Yet to be rolled out
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira

Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the agronomic practice • Labour intensity • Limited knowledge and information and low literacy levels among the farmers. • Capacity building is required to impart knowledge and skills in appropriate use and application of solarization • Farmers need to understand the proper use and application of solarization to avoid buying inappropriate polythene and minimize health, environmental and social hazards
Recommendations for addressing the challenges	• Establish avocado innovation platforms • There is need to train the agricultural extension county officers as ToTs on appropriate use of solarization. This will help in reaching the farmers with the correct information. Polythene disposal should be done carefully to avoid environmental, health and social hazards. Liaise with the local agricultural extension and environmental officers for farmer empowerment and guidance on reuse and polythene disposal.
Lessons learned	• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the technology of solarization bed for weed control • Availability of market for avocado is essential • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms • Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation, productivity and profitability productivity
Social ,environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of polythene is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge • Women have less access to land that can be used for avocado farming • Women and youth have limited access to education, training and extension services
Gender related opportunities	• Women stand to benefit from increased production due to timely operations, increased yields and sales

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 and credit • 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 to lack of awareness
VMG related opportunities	Use of this technology will improve weed management leading to increased productivity, increase availability of avocado for consumption which will improve food security hence improved health of VMGs. Ultimately, high value of the crop will lead to economic empowerment of VMGs
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Guidelines are yet to be developed
F: Status of TIMP Readiness (1 = Ready for up- scaling; 2=Requires validation; 3=Requires Research **)**	Requires research and validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD, Counties, Chemical companies

2.7.19 Stale seed bed for weed control

2.7.19 TIMP Name	**Stale seed bed for weed control**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
	 *Datura stramonium among other weeds (Source: Hottensiah Mwangi, KALRO)*

Problem addressed	Competition from weeds prevents avocado getting available resources and can cause weak and stunted growth. This poses a problem especially for young avocado. However, the effect depends on weed density and diversity, stage of weed growth and environment. Common grass weeds causing major challenges include crab sanguinalis (*Digitaria sanguinalis*) and goose grass (*Eleusine indica*), while broadleaved weeds include Palmer amaranths (*A. palmer*), Red pigweed *(A. retroflexus*), Datura (*Datura stramonium*) Purple nutsedge (*Cyperus rotundus*) and Yellow nutsedge (C. Esculentus. Weed problem is aggrevated by wrong timing and poor method of weed control.
What is it?(TIMP description)	Stale seed bed "false" is where seeds are allowed to germinate by rainfall or wetting and killing them (1-2 flushes of the weeds) before sowing the clean certified avocado seedlings. They are killed using glyphosate, sulfosate and glufosinate. At this stage shallow or use of non-residue paraquat may be used to destroy dense flush young weed seedlings. This is followed by sowing the selected avocado seedling. Most weed seeds have the potential to develop under condition of adequate soil moisture and temperature (50^0F at a depth of 2 inches) causing major problem. Several passes are made in soil during preparation of stale beds using rotoSpike tooth hallow so as to destroying the emerging weeds. The weed seeds are allowed to germinate as weather permits, then they are dessicated or plowed.
Justification	With sound knowledge of weed phenology and other factors like local temperature, irrigation and humidity it is possible to predict when certain weeds will cause challenges in Avocado seedbed.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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	On-farm experimentation and plot demonstrations.
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release stale seed bed for weed control in avocado • Avail platform for interaction of Avocado value chain stakeholders • Capacity building and training on use of stale bed
Partners/stakeholders for scaling up and their respective roles	• Public (MoALD) and private partners • Chemical companies for back stopping. • FIPs (Farmer Input Promotion) for promotion.

	• Farmer Groups for activity implementation and promotion. • Service provider agencies e.g. micro-finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. Community Action for Rural Development (CARD) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc
C: Current situation and future scaling up	
Counties where already promoted if any	Yet to be determined
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology • Labour intensity • Limited knowledge, information and low literacy levels among the farmers. • Capacity building is required to impart knowledge and skills in safe use and application of stale beds. • Farmers need to understand the proper use of stale beds
Recommendations for addressing the challenges	• Establish avocado innovation platforms • Train county agricultural extension officers as ToTs on appropriate use of stale beds. They will help to reachout the farmers with the information • Polythene disposal should be done carefully to avoid environmental, health and social hazards • Liaise with the agricultural extension and environmental officers for farmer empowerment and guidance on use of stale bed
Lessons learned	• 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 will help in adoption of the stale seed bed technology • Availability of market is essential • Partnership is important in technology dissemination and adoption which can be facilitated through innovation platforms • Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of stale beds

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge • Women have less access to land that can be used for avocado farming • Women and youth have limited access to education, training and extension services
Gender related opportunities	Women stand to benefit from increased production due to increased yields and sales
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 and credit • 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 to lack of awareness
VMG related opportunities	• Use of this technology will improve weed management leading to increased productivity. Increase availability of avocado for consumption which will improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
F: **Status of TIMP Readiness (**1=Ready for up- scaling; 2 =Requiresvalidation; 3= Requires Research**)**	Requires research and validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD, Counties, Chemical companies

2.7.20 Transplanting Avocado for weed control

2.7.20 TIMP Name	Transplanting Avocado for weed control
Category (i.e. technology, innovation or management practice)	Management Practice

A: Description of the technology, innovation or management practice	
Problem addressed	Competition from weeds prevents avocado getting available resources and can cause weak and stunted growth. This poses a problem especially for young avocado. However, the effect depends on weed density and diversity, stage of weed growth and environment. Common grass weeds causing major challenges include crab sanguinalis (*Digitaria sanguinalis*) and goose grass (*Eleusine indica*), while broadleaved weeds include Palmer amaranths (*A. palmer*), Red pigweed *(A. retroflexus*), Datura (*Datura stramonium*) Purple nutsedge (*Cyperus rotundus*) and Yellow nutsedge (C. Esculentus. The weed problem is aggrevated by wrong timing and poor method of weed control.  *Bidens pilosa among other weeds* *(Source Hottensiah Mwangi, KALRO)*
What is it (TIMP description)	This is the process of preparing and raising seedlings in weed free conditions and transplanting into a clean seed bed to help plants overcome weeds competition. In order to prepare appropriate soil media,, mix the soil with manure in the ratio 1:1. This is put in environmentally friendly bags/papers. One clean certified avocado seed variety is sowed per polythene bag and kept in a slight shade were they will be watered regularly for about 40-70 days before transplanting. Timing of avocado seed maturity in the nursery should coincide with the expected rains. The nursery is prepared during the dry season when there is less work in the fields. Prepare the holes for planting avocado with manure as recommended in particular field. Immediately rains start, remove the avocado from nursery with each polythene paper having one seedling, cut and plant in the already prepared holes. Weed regularly depending on location using suitable method
Justification	With sound knowledge of avocado nursery, weed phenology and other factors like temperature, irrigation and humidity at the local area known, it is possible to predict when certain weeds will raise problems in avocado nursery and to remove them easily as compared to the field. Transplanted avocado has less weeding to be done if appropriate weeding method is used. Transplanting

	has advantage in that when rainfall is delayed, avocado watering intervals are reduced so as to make the crop stress resistant in the nursery. This is a climate smart technology for resilience, food security and improvement lively hoods
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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	On-farm experimentation and plot demonstrations
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release transplanting technology • Avail platform for interaction of Avocado value chain stakeholders • Capacity building and training on use of polythene and transplanting Avocado
Partners/stakeholders for scaling up and their respective roles	• Public (MoALD) and private partners • Chemical companies for back stopping. • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. micro-finance agencies and banks for credit provision, agro-vets for input supply • Processors and manufacturers to create market for produce • Aggregators e.g. Community Action for Rural Development (CARD) for economy of scale sales and marketing • Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc
C: Current situation and future scaling up	
Counties where already promoted if any	Yet to be determined
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of technology uptake • Labour intensity • Limited knowledge and information and low literacy levels

	among the farmers. • Capacity building is required to impart knowledge and skills in safe use of polythene bags, avocado nursery and transplanting. • Farmers need to understand the proper use transplanting technology
Suggestions for addressing the challenges	• Establish avocados innovation platforms • Promotion of the transplanting technology in the suitable areas • Train county agricultural extension officers as ToTs on appropriate use of transplanting avocados so that information can reach the farmers. Polythene disposal should be done carefully to avoid environmental, health and social hazards. Liaise with the Agricultural extension and environmental officers for farmer empowerment and guidance on use of transplanting technology
Lessons learned	• 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 technologies • Availability of market is essential • Partnership is important in technology dissemination and adoption which can be facilitated through innovation platforms • Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of transplanting technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	• The management practice may not be adopted if the gender targeted is women who are already overburdened • Women have less access to information, technology and knowledge • Women have less access to land that can be used for avocado farming • Women and youth have limited access to education, training and extension services
Gender related opportunities	Employment opportunities exist for women and youths in performing the operation
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 and credit

	• 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 to lack of awareness
VMG related opportunities	Employment opportunities exist for women and youth, and those recovering from drugs in performing the operation
E: Case studies/profiles of success stories	
Success stories	Laikipia County, Solio Villages and Siaya.
Application guidelines for users	1. Advances in Research for Development. ASARECA Success stories. 2011 2. Weed control leaflets/ manuals 3. Information and instructions always displayed on the labels attached to container on how to use
F: Status of TIMP Readiness (1=Ready for up- scaling; 2= Requires validation; 3= Requires Research **)**	Requires research and validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD, Counties, Chemical companies

2.7.21 Mechanical weeding

2.7.21 TIMP Name	**Mechanical weeding**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Manual weeding by hand is a common and efficient method for weed control especially for smallholder farmers. However, this is labor intensive and is not practical for large farms 

	Weeding using panga in avocado field  *Weeding using a "Muro"*  *Weeding using a "jembes"* *(Source Hottensiah Mwangi, KALRO)*
What is it? (TIMP description)	Large Avocado plantations conventionally employ the use of herbicides for easy and quicker removal of the understory vegetation. However, this is often complemented by mechanical weeding especially during rainy periods. Herbicide weed control may promote the invasion of herbicide-resistant weeds. It also strongly impacts vegetation biodiversity. Furthermore, concern about the effects of herbicides on the environment and the need to reduce herbicide residue. A more sustainable alternative is mechanical weeding. However, these desirable effects may have adverse economic impact as mechanical weeding requires higher labour input compared with herbicide application, which may ultimately reduce profits
Justification	Weeds if not controlled will take over, win the competition, lower productivity and profitability. The emerged weeds can be managed effectively by timely mechanical weeding
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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	On-farm experimentation and plot demonstrations
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release improved mechanical weeding • Avail platform for interaction of avocado value chain

	stakeholders • Participatory implementation • Stakeholder sensitization
Partners/stakeholders for scaling up and their respective roles	• Public (MOALD) and private partners • Processors and manufacturers to create market for produce • Aggregators e.g. Community Action for Rural Development (CARD) for economy of scale sales • Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc
C: Current situation and future scaling up	
Counties where already promoted if any	Yet to be determined
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Labour intensity • Low use of agronomic practices • Appropriate implements are not readily available in the market such as subsoilers  *Subsoiling using a subsoiler for minimum soil disturbance*
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Work with Jua Kali industries for fabrication of appropriate implements
Lessons learned	• Chances of success are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the technologies • Availability of market is essential • Partnership is important in technology dissemination and adoption that can be facilitated through innovation platforms • Access and use of appropriate weeding tools (technology) will provide timely weed control with reduced drudgery to

	enhance crop production
Social, environmental, policy and market conditions necessary	Sensitization of communities on the mechanical weed management practices for sensitive young Avacado plants
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge • Women have less access to land that can be used for avocado farming • Women and youth have limited access to education, training and extension services
Gender related opportunities	• Opportunities exist for women employment in mechanical weeding
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 to lack of awareness
VMG related opportunities	VMGs will benefit from consumption of healthy avocado hence improved nutrition
E: Case studies/profiles of success stories	
Success stories	Tharaka nithi
Application guidelines for users	ToT manuals to include weed management TIMPs
F: Status of TIMP Readiness (1= Ready for up- scaling; 2= Validation 3= Requires further research)	Requires further research and validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD in Counties

2.7.22 Crop rotation in Avocado

2.7.22 TIMP Name	Crop rotation in Avocado
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Diverse weed species and rich weed seed banks contribute to high yield losses in Avocado cropping systems
What is it?(TIMP description)	• A good successive weed control strategy starts with a farm plan having a rotation schedule for optimal avocado production. The plan outlines a planned sequence of crops that will be grown in the same field year after year. The land should be divide into a number of distinct areas where plants of same type are kept together e.g. Watermelon – Peas – Pursley - carrot or onions
	• Crop rotation adds diversity to the cropping system, increase sustainability of the system and provides the foundation of long term weed management. Rotation is the most critical time for obtaining good crop weed control. However, before making the decision factors such as environment, weeds present, time of year, crop rotation, irrigation methods and herbicide cost should be considered. Good rotation is achieved by combining cultural and herbicide weed management strategies. In achieving this two options are available: 1) form beds well before planting and let flush weeds grow, then knock them down with a post emergence herbicide or shallow weeding, or 2) form beds just before planting and then remove any emerged weeds. This may involve the use of pre-plant herbicides (such as glyphosate, paraquat and diquat) depending on weeds present, stage of weed growth and herbicide cost. One may start by applying appropriate herbicide that targeting specific weeds. In order to reduce weeding costs, use hooded spray and direct to row middles when weeds are small • Detailed weed information (annual broad leaved or grasses) recorded or maps kept over time will help improve management decision in crop rotation
Justification	Planting a wide variety of crops with varied characteristics reduces the likelihood that specific weed species will become adapted to the system and become problematic. The successive rotation systems for weed suppression appears to be based on the use of crop sequences that employ varying patterns of resources competition, allellopathy interference, soil disturbance and mechanical damage to provide an unstable and frequently inhospitable environment that provides the proliferation of a particular weed species. Correct timely crop rotation minimizes weeds population in avocado crop and reduces weed seed banks so that there is less future infestations. Different crops grown in rotation break the cycle of weeds. The diversity of weed management strategies used for different

	crops also increases weed diversity and reduces prevalence of problem weeds that can build over time. Planting dates are important. The most effective management strategy must be made before crop is planted and this is taken care of when planning the rotation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff, Agripreneurs
Approaches 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	On-farm experimentation and plot demonstrations
	 *Farmers learning on weed management in the field*
Critical/essential factors for successful promotion	• Applied and adaptive research to test, validate and release improved mechanical weeding • Avail platform for interaction of avocado value chain stakeholders • Participatory implementation • Stakeholder sensitization
Partners/stakeholders for scaling up and their respective roles	• Public (MOALD) and private partners • Jua Kali artisans • Processors and manufacturers to create market for produce • Aggregators e.g. Community Action for Rural Development (CARD) for economy of scale sales • Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc
C: Current situation and future scaling up	
Counties where already promoted if any	Yet to be determined
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu,

	Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology • Small farms due to family subdivisions • Labour intensity • Rotation schedules for avocado not readily available
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Information dissemination on the practices • Promotion of the technology in the suitable areas • Work with farmers to validate known schedules from other researchers or countries in different Avocado growing regions
Lessons learned	• 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 is essential • Partnership is important in technology dissemination and adoption facilitated through innovation platforms • Use of appropriate crop rotation will provide timely weed control which will enhance crop production
Social, environmental, policy and market conditions necessary	Sensitization of communities on the crop rotation practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and credit • Women and youth have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge • Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women in production and marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 in transporting the produce
E: Case studies/profiles of success stories	
Success stories	Avocado farmers in Murang'a County.
Application guidelines for users	Production manuals to include crop rotation weed management TIMP
F: **Status of TIMP Readiness (**1=Ready for up-scaling; 2=Validation 3=Requires further research**)**	Ready for validation
G: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Njuguna J.
Partner organizations	MoALD in Counties

2.7.23 Safe use of herbicides in Avocado

2.7.23 TIMP Name	**Safe use of herbicides in Avocado**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Excessive herbicide application to crops and the soil, use of herbicides for spraying crops without wearing the right protective clothing, storage of herbicides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, use without following the guidelines provided on the labels (e.g. rate and pre-harvest interval), disposal of expired herbicides and empty containers and inadequate enforcement of global and national policies, and regulation on use of pesticides.
What is it? (TIMP description)	In order to ensure safety avocado stakeholders, crop protection teams need to sensitize industry players on various safety measures that include: safe handling and use of herbicides right from transportation from the agro-dealers to storage in their houses, mixing procedures and their application in the field, safety of the spray operators and the environment at large. The technology will include correct methodologies for proper herbicide disposal to minimize pollution of the environment.
	 *Safety measures taken in spraying*

	(Source: Hottensiah Mwangi, KALRO)
Justification	Although reported cases of improper and misuse of pesticides are common in many areas where avocado is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users to be made aware of the best practices that should be used when handling herbicides. There has been reports of increase of chronic diseases in human beings.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Avocado producers, Agripreneurs
Approaches 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 employ safe use herbicide application in maize varieties • Avail platform for interaction of maize value chain stakeholders • Development of agronomic practices for cabbage • Collaboration between all partners, willingness of farmers to adhere to proper guidelines • Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	• MoALD to conduct extension services and farmer trainings • Individual Farmers, farmer groups/CBOs to participate in the implementation of the various technologies for maize production • KALRO and Universities to develop the technologies and conduct ToTs • AAK, PCPB, KEPHIS
C: Current situation and future scaling up	
Counties where already promoted if any	Yet to be determined
Counties where TIMP will be upscaled	All Avocado growing Counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho,

	Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of technology • Labour intensity and requires skilled manpower • Change of mindset in favour of current practices maybe difficult to achieve • Illiteracy and inadequate capacity to use herbicides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of herbicides • Use of banned pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose herbicides properly
Suggestions for addressing the challenges	• Establish avocado innovation platforms • Capacity building and sensitization forums for both farmers and agro dealers using participatory approach. • Formation of youth spray teams • Establishment of aggregation centres for herbicide containers • Training of extension staff and lead farmers as ToT • Increase surveillance along the border points and enforce the laws
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 technologies • Availability of market is essential • Partnership in technology dissemination and adoption facilitated through innovation platforms • Some of the aspects of this technology is capital intensive e.g. collection and incineration of pesticide containers that may not be accessible by most farmers' groups. • Illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of herbicides
Social, environmental, policy and market conditions necessary	Organized collective marketing channels critical for benefits to be derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Information not yet available
Estimated returns	Yet to be estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• Technology is not safe for use by expectant women and the physically challenged persons because of it hazardous/dangerous nature • Herbicides and protective gear are expensive and most women may not afford them • Lack of knowledge by farmers on the dangers of

	herbicides especially on storage and disposal • Low levels of illiteracy and inability to read and interpret the content of the herbicide labels especially on re-entry period after spraying and PHI which can cause herbicides poisoning
Gender related opportunities	• Formation of spray teams by men • Formation of surveillance/scouting groups by women
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some dangerous products may not be handled by vulnerable groups • Herbicides are expensive for most youths and physically challenged groups
VMG related opportunities	• Safe use of herbicides practice can easily be undertaken by the youth as an enterprise by forming spray teams in the wards in each county
	• Youths to offer spray calibration services to farmers as an enterprise • Youths to help in the collection of herbicide containers and assist in the incineration processes by AAK • Youth to own and operate agro chemicals that stock right herbicides and offer advisory services to farmers at the agrovet shops
E: Case studies/profiles of success stories	
Success stories	• The AAK has trained youth spraying teams that help in the spraying of the farms in a few counties thus reducing cases of people being exposed to herbicides • Some counties who have aggregation centres by AAK for collection of herbicide containers that has led to reduction of these containers on farms • Safe use of herbicide campaigns by AAK, PCPB, KALRO and MoALD
Application guidelines for users	• Developed curriculum by AAK and PCPB • modules and manuals for plant doctors developed by CABI • Guidelines, manuals, brochures developed by KALRO
Status of TIMP readiness: (1= Ready for up-scaling; 2= Requires validation; 3=requires further research)	Ready for up-scaling
F: Contacts	
Contacts	Institute Director, KALRO-Thika; P.O. Box 220-01000. Thika Email: director.hri@kalro.org Phone: 020-2055038
Lead organization and scientists	KALRO: Mwangi H.; Momanyi V.; Nyaga A.
Partner organizations	MoALD, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

References/ Further reading

1. Plantwise Knowledge Bank
2. Prune out light infestations or dab insects with a Q-tip dipped in rubbing alcohol.
3. Do not over water or over-fertilize — mealybugs are attracted to plants with high nitrogen levels and soft growth.
4. Commercially available beneficial insects, such as ladybugs, lacewing and the Mealybug Destroyer (*Cryptolaemus montrouzieri*), are important natural predators of this pest.
5. Use the Bug Blaster to hose off plants with a strong stream of water and reduce pest numbers. Washing foliage regularly with a leaf shine — made from neem oil — will help discourage future infestations.
6. Safer® Insecticidal Soap will work fast on heavy infestations. A short-lived natural pesticide, it works by damaging the outer layer of soft-bodied insect pests, causing dehydration and death within hours. Apply 2.5 oz/ gallon of water when insects are present, repeat every 7-10 day as needed.
7. Neem oil disrupts the growth and development of pest insects and has repellent and antifeedant properties. Best of all, it's non-toxic to honey bees and many other beneficial insects. Mix 1 oz/ gallon of water and spray every 7-14 days, as needed.
8. BotaniGard ES is a highly effective biological insecticide containing *Beauveria bassiana*, an entomopathogenic fungus that attacks a long-list of troublesome crop pests – even resistant strains! Weekly applications can prevent insect population explosions and provide protection equal to or better than conventional chemical pesticides.
9. Fast-acting botanical insecticides should be used as a last resort. Derived from plants which have insecticidal properties, these natural pesticides have fewer harmful side effects than synthetic chemicals and break down more quickly in the environment.

2.8 Post-Harvest Management

2.8.1 Fruit harvesting tools

2.8.1 TIMP name	**Fruit harvesting tools**
Category (i.e. technology, innovation or management practice)	Innovation
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 avocado
What is it? (TIMP description)	 *Harvesting tool used in mango fruit* Fruit harvesting tool designed to assist in harvesting of fruits

	from tall trees to minimize damage of fruits banging to the ground. The tool has long pole and basket hooked with a cutter. Once the fruit is harvested it drops in the basket and emptied in to a collection container.  *Avocado harvesting using a kiondo for collection*
Justification	• Poor harvesting method is one of the main cause of post-harvest losses in avocado fruits due to mechanical injuries. Use of fruit harvesting tool prevents the fruit from dropping to the ground, thus minimizing postharvest injuries and losses
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, processors, agripreneurs
Approaches 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
Partners/stakeholders for scaling up and their roles	Extension, NGOs, agro-chemical companies, Research institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Meru, Machakos, Kilifi, Tana River
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho,

	Kiambu, Nandi, 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 • Popularization of the innovation
Lessons learned in upscaling, if any	The harvesting tool need be fabricated with locally available materials
Social, environmental, policy and market conditions necessary	The extra cost of production must be matched with better returns – better prices for the avocado fruits
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not established
Estimated returns	To be established
Gender issues and concerns in development and dissemination adoption and scaling up	• Youths are the ones who usually perform the task of harvesting • Women may not be able to perform the task due to the height of the crop • Women and youth have limited access credit to purchase the harvesting implements • Women and youth may have limited access to education, training and extension services • Women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment creation for youth in fabricating the tool • Employment opportunities for the youths using the tool for harvesting
VMG issues and concerns in development and dissemination, adoption and scaling up	• The tool may be a suitable option for some VMGs while others may not, depending on the type of their disability • VMGs and youth have limited access credit to purchase the harvesting implements
	• VMGs and youth may have limited access to education, training and extension services • VMGs may have less access to agricultural information, technology and knowledge
VMG related opportunities	• Employment opportunities in tool fabrication and engagement in harvesting, depending on the type of disability.
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Reduced mechanical injuries in harvested fruits leading to reduced postharvest losses
Application guidelines for users	1. Flyer or poster showing the parts of the tool and how is used to harvest avocado fruits 2. Photo evidence of reduced injuries on harvested fruits 3. Video demonstrating use of the tool
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	KALRO, TECHNOSERVE, HCD, FPEAK

2.8.2 Sorting and grading of avocado

2.8.2 TIMP Name	**Sorting and grading of avocado**
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 Avocados
What is it? (TIMP description)	• Sorting is done to remove physical damaged, diseased, insect damaged, rotten, bruised, and discolored and debris. • Grading is categorization of avocado fruits according to size, weight, maturity, physical damage, and market demand.
Justification	• Sorting helps to eliminate avocado fruits of poor quality and prevent cross contamination between spoilt and good fruits. • Avocados of superior quality fetch higher prices in the market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers , traders, processors, agripreneurs
Approaches 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	• Application of good agricultural practices to have a good crop • Increase of productivity • Application of good harvesting technologies
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 avocado to disseminate the practices

C: Current situation and future scaling up	
Counties where already promoted if any	Embu
Counties where TIMP will be upscaled	All avocado growing counties including Murang'a, Kirinyaga, Nandi and Meru
Challenges in dissemination	• Lack of knowledge and appropriate sorting and grading technology • Negative attitude by farmers towards adoption of new agricultural TIMPs • Low uptake because of lack of demonstrated success.
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 • Organizing visits to successful farmers and cases.
Lessons learned in upscaling if any	• Good prices fetched from high quality avocado
Social, environmental, policy and market conditions necessary for development and upscaling	• 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	• Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels.
Gender related opportunities	• Employment opportunities exist for women and youth in the operation of the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Not yet documented
Application guidelines for users	1. Brochures, leaflets, factsheets and manuals providing guidelines on sorting and grading avocado 2. Video demonstrating use of the tool
F: Status of TIMP readiness (Ready for	Ready for upscaling

upscaling; Requires validation; Requires further research**)**	
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO
	Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALD, NGOs, CBOs

2.8.3 Zero energy brick cooler

2.8.3 TIMP Name	**Zero-energy brick cooler**
Category (i.e. technology, innovation or management practice)	Technology  *Zero energy brick cooler*
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses (>50%) caused by lack/limited cooling technologies for avocado
What is it? (TIMP description) Zero energy brick cooler	The Zero Energy Brick Cooler (ZEBC) consists 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 the water in the sand.
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, house hold consumers, agripreneurs

Approaches 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 • Promotional materials • (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	• The sand should be continuously moist. Cooling is more effective in dry and windy environment
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the avocados • Scientists and agricultural extension workers to provide farmers with knowledge on ZEBC
C: Current situation and future scaling up	
Counties where already promoted if any	Embu
Counties where TIMP will be upscaled	All avocado-growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 upscaling 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 upscaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the ZEBC
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	• Women and youth may have limited access to productive resources such as land, quality seed and credit • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels

Gender related opportunities	• Employment opportunities exist for women and youth in the operation of the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have limited access to productive resources such as land, credit, and quality seed • VMGs may 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 in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, among others have used the technology to reduce losses and extend shelf-life for avocados and other fruits as well as vegetables leading to improved marketing of the products.
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALD, NGOs, CBOs

2.8.4 Avocado storage using CoolBot^{TM} technology

2.8.4 TIMP Name	**Avocado storage using CoolBot^{TM} technology**
Category (i.e. technology, innovation or management practice)	Technology

	 *CoolBot™ technology facility*
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) Coolbot™	It is a low cost postharvest temperature management that improved 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 lesser 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.
Justification	CoolBot provides inexpensive and 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, agripreneurs
Approaches 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	• Increasing postharvest training and direct farmer outreach • Documenting and issuing out guidelines on postharvest management
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of avocado

	• 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 upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling avocados • Limited awareness of the technology by farmers Inadequate funds to install the Coolbot™
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 upscaling if any	• Linking entrepreneurs to credit and market enhances adoption of Coolbot™ 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 upscaling	• 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 Electricity costs
Estimated returns	• Increased income. Farmers can store avocados 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 • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision

	makers at the household and community levels.
Gender related opportunities	• Employment opportunities exist for the youths in the installation of the CoolbotTM
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources required in the installation of the CoolbotTM • 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 in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Fruit and vegetable farmers in Embu, Kirinyaga and others Example is Karurumo Smallholder Horticulture Aggregation and Proces sing Centre, in Embu County. Use of the technology has enabled the Centre to sell their Avocado fruits to different buyers for between KES 6.00 and 10 .00 a piece, up from the KES 3.00 – 5.00 offered by most buyers during the peak season.
Application guidelines for users	Available from KALRO: • Factsheets, • Manuals • Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, Ndambuki, Francis Wayua, Finyage Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALFC, NGOs, CBOs

2.8.5 Wakati^{TM} storage technology

2.8.5 TIMP Name	**Wakati^{TM} storage 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 shelf life lengthening technologies for avocados

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 by oxidizing (ozone oxidation). It is a 1 x 1 m^2 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, hence enables farmers to have 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). It is appropriate for rural farmers and agro-dealers.
Approaches 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™ One 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 Wakati™Technology
C: Current situation and future scaling up	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira

Challenges in dissemination	• Lack of knowledge on the technology and the benefits of cooling avocados. • Limited awareness of the technology by farmers Inadequate funds to install the WakatiTM
Suggestions for addressing the challenges	• Linkage to credit facility providers to promote • commercialization, advocacy for its widespread use
Lessons learned in upscaling if any	• No reports accessed
Social, environmental, policy and market conditions necessary for development and upscaling	• To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the WakatiTM
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 • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels.
Gender related opportunities	• Employment opportunities exist for the youths in the installation of the WakatiTM
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources required in the installation of the WakatiTM • 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 in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, among others.
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000

	Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, James Ndambuki, Francis Wayua, Finyage Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALFC, NGOs, CBOs

2.8.6 Use of crates during packaging, storage, transportation and marketing of avocados

2.8.6 TIMP name	**Use of crates during packaging, storage, transportation and marketing of avocados**
Category (i.e. technology, innovation or management practice)	Technology  *Nestable crate*
A: Description of the technology, innovation or management practice	
Problem addressed	• Poor packaging during transportation lead to mechanical injuries and ultimately high postharvest losses in avocado
What is it? (TIMP description)	Plastic crates (ordinary bread crates) which can be used to package avocado fruits during storage and transportation to minimize mechanical damages Nestable crates are space-saving version that should be promoted for transporters
Justification	 *Avocado fruits packaged in sacks.* *Source: Charity Gathambiri, KALRO* Most traders/transporters do not package avocado 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 transportation.

	 *Avocado fruits packaged in crates* *Source: Charity Gathambiri, KALRO*
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado producers, aggregators, traders, agripreneurs
Approaches 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, demonstration of cost/benefits associated, policy directive that prohibits poor packaging and promotes the use of crates
Partners/stakeholders for scaling up and their roles	Extension, NGOs, Research institutions, Manufacturers of crates
C: Current situation and future scaling up	
Counties where already promoted, if any	Embu, Meru, Kilifi,
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Availability and cost of the plastic crates if demand is created • Attitudes especially with transporters
Suggestions for addressing the challenges	• Build capacity for traders on advantages of using crates in reducing losses • Policy directive that prohibits the use of sacks or open lorries to transport perishable produce
Lessons learned in upscaling, if any	• Negative attitude from traders • Need for space 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 avocado fruits
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Ordinary bread crate (500 – 700 KES) Nestable crate (750 KES)
Estimated returns	Not yet done – need for cost benefit analysis study
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels.
Gender related opportunities	• Employment opportunities exist for the youths in the practicing the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may not easily adopt the technology since it is physically/manually involving • 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 in the operation of the TIMP for the VMGs.
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 when the technology is used
Application guidelines for users	1. Flyer, poster or video showing how avocados are packaged in the crates 2. Photo evidence of reduced injuries on harvested fruits
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	TECHNOSERVE, HCD, FPEAK

2.8.7 Use of Hexanal to extend avocado shelf life

2.8.7 TIMP Name	Use of Hexanal to extend avocado 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 avocado fruits, its perishability results in postharvest losses 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 resulting to shelf life extension by up to 25 days compared to 14 days when they are not sprayed.
Justification	The hexanal formulation spray extends the shelf life of avocado fruits and reduce rotting.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado farmers, traders/exporters of avocado fruits, agripreneurs
Approaches 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 in 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 avocados • 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 value chain
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 upscaling if any	• Need to create awareness on the technology
Social, environmental, policy and market conditions necessary for development and upscaling	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	To be done
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 • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Employment opportunities exist for the youths in the performing the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may not easily adopt the technology since it is involving physically • VMGs may 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	• Use of the technology can reduce postharvest losses and enable VMGs have enough avocado to consume, hence get macro- and micronutrients • Opportunities exist in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Banana farmers in Embu and Meru
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals

	3. Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALD, NGOs, CBOs

2.8.8 Use of Hot water treatment

2.8.8 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 avocado fruits, postharvest rots in avocado fruits results in losses and short shelf life.
What is it? (TIMP description) Hot water treatment	The technology involves dipping freshly harvested avocado fruits in water heated at 50-52^{o}C for 5-10 minutes. The treatment is effective in controlling anthracnose. Hot water treatment extends avocado fruit shelf life up to 21 days of storage.
Justification	Postharvest rot is one of the main cause of postharvest losses in avocado fruits. Hot water treatment moderates 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 avocado fruits, agripreneurs
Approaches 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 • Strategic trainings on postharvest handling for the small scale farmers and traders
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained on use of avocado 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 upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 upscaling if any	No documentation accessed
Social, environmental, policy and market conditions necessary for development and upscaling	To enhance adoption, promotions and working with industry, farmer cooperatives and other strategically identified stakeholders will be essential.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be 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 • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for the women and youths in the performing the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may not easily adopt the technology since it is physically involving • 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 in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Avocado farmers in Murang'a
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALFC, NGOs, CBOs

2.8.9 Avocado Waxing Technology

2.8.9 TIMP Name	**Avocado 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 avocado fruits, its perishability results in postharvest losses and short shelf life.
What is it? (TIMP description) Waxed avocado fruits	 ***Waxed avocado fruits*** The technology involves dipping mature green avocado fruits in 6% bee-carnauba wax for 8 seconds. This results in improved avocado shelf life and also quality.

Justification	Avocado fruits perishability is one of the main cause of postharvest losses. Therefore fruits waxing reduces respiration rate of the fruits thus extending their shelf life.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and traders/exporters of avocado fruits.
Approaches 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 avocado.
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained on use of avocado 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 on avocado
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 upscaling if any	Create awareness on the technology
Social, environmental, policy and market conditions necessary for development and upscaling	To enhance adoption, work with industry, farmer cooperatives, hot water treatment technology
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 • Women and youth may have limited access to education, training and extension services • Women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for the women and youths in the performing the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• 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 in the operation of the TIMP for the VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Avocado farmers in Murang'a
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; 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 Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALFC, NGOs, CBOs

2.8.10 Modified Atmosphere Packaging of Avocado (Ziploc® and Xtend® bag packaging)

2.8.10 TIMP Name	**Modified Atmosphere Packaging of Avocado (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 limited knowledge on appropriate

	packaging of avocado
What is it? (TIMP description)	Ziploc® and Xtend® bags are modified atmosphere bags characterized by high moisture vapor transmission rates. This assures that excess moisture is eliminated and in the event that condensation forms within the bag.
Justification	The Ziploc® and Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of fruits for between 5-7 days
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and sellers of fresh fruits (green grocers). It is appropriate for rural farmers and agro-dealers
Approaches 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 avocado
Partners/stakeholders for scaling up and their roles	• Farmers groups to be trained in postharvest handling of the avocados • 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 in Avocado fruits
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 upscaling if any	• Can reduce temperatures to considerable levels. • Is a cheap method
Social, environmental, policy and market conditions necessary for development and upscaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the modified atmosphere packaging
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 • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for the women and youths in practicing the TIMP
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMG may not easily adopt the technology since it is involving physically • 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 in the operation of the TIMP for the VMGs.
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	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research**)**	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, James Ndambuki, Francis Wayua, Finyange Pole, Violet Kirigua and Lusike Wasilwa
Partner organizations	Agricultural University Colleges, MoALD, NGOs, CBOs

2.9 Value Addition

2.9.1 Avocado Oil

2.9.1 TIMP name	**Avocado Oil**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado
What is it? (TIMP description)	Avocado oil is one of few edible oils derived from their flesh. It is pressed from the flesh pulp surrounding the avocado pit. This process takes the pulp of the avocado, and mashes it up in a giant mixer, turning it into something resembling puree. This puree then goes into a centrifuge, where it spins with enough force to separate the oil and the water contained in the pulp. This is the oil which is bottled and sold. In processing through cold press, temperature is very important. The temperature should not rise above 50 degrees Celsius and this will help retain all the healthy properties of the avocado fruit.  Avocado Oil (*source*:fruitprocessing.com)
Justification	Diversification of avocado food products will enhance consumption of avocado and its demand, thus spurring increased production. Avocado can be pressed to make oil, which is used in cooking or making beauty Products
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado oil • Availability of quality avocado oil standards.
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado oil production technology • KEBS – Standards formulation for avocado oil, certification of private avocado oil processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado oil • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	Limited awareness about the technology by farmers
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 • Working with KEBS to develop standards for avocado oil • Linking farmers to credit facility providers to get capital to engage in avocado oil production agribusiness.
Lessons learned in upscaling, if any	No documentation accessed
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 avocado oil to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Oil extraction equipment is the main cost item and come in varied quality and capacity

Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado oil
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge • VMGs may have limited access to productive resources such as land, credit, and quality seed • VMGs may 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	• Opportunity to produce, trade in, and consume locally produced avocado oil based products • Women can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	To be documented
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP readiness (1=Ready for upscaling, 2=requires validation, 3=requires further research)	Ready for up-scaling
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).

Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

2.9.2 Avocado pulp

2.9.2 TIMP name	**Avocado pulp**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation, or management practice	
Problem addressed	Limited utilization of avocado Short shelf life for the ripe avocados
What is it? (TIMP description)	Avocado pulp is the juicy part of avocado which is greenish yellow in color. This is made by processing of fresh avocados fruit by washing and thereafter grating to remove culls. The fruit is subsequently peeled and the seed removed after which the pulp is mixed and packaged  *Avocado pulp*.(*source:* fruitprocessing.com)
Justification	Diversification of avocado food products will enhance consumption of avocado, and demand thus spur increased production. Avocado can be processed to make pulp, which can either be fortified or blended with other fruit pulp or yogurt to make various products including flavored yogurt and mixed fruit paste, among others. Use of avocado pulp will improve the human nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado pulp • Availability of quality avocado pulp standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado pulp production technology • KEBS – Standards formulation for avocado pulp, certification of private avocado pulp processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado pulp • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	Limited awareness about the technology by farmers
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 • Working with KEBS to develop standards for avocado pulp • Linking farmers to credit facility providers to get capital to engage in avocado puree production agribusiness.
Lessons learned in upscaling, if any	This a new technology being introduced
Social, environmental, policy and market	• Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers,

conditions necessary for development and upscaling	respectively. • There is need to develop quality standards for avocado pulp to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• Pulping and packaging equipment are main cost items
Estimated returns	• Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado pulp
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 related opportunities	• Opportunity to produce, trade in, and consume locally produced avocado pulp • Nutritious products can be made from Avocado flour contributing to the nutrition of VMGs. • Women can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	None. This is a new technology
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1 =Ready for upscaling, 2 =requires validation, 3= requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100,
	Nairobi, Kenya.
Lead organization and	KALRO

scientists	J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

GAPS

- Gross margin and market demand for avocado pulp

2.9.3 Avocado Paste

2.9.3 TIMP name	**Avocado Paste**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado,high postharvest losses due to high perishability, and low market prices
What is it? (TIMP description)	Paste extracted from ripe avocado, pasteurized and packaged  *Avocado paste drink* (*source*: fruitprocessing.com)
Justification	Diversification of avocado food products will enhance consumption of avocado and its demand, thus spurring increased production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado paste • Availability of quality avocado paste standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado paste production technology • KEBS – Standards formulation for avocado paste, certification of private avocado oil processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado paste • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None.
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	• Limited awareness of the technology by farmers
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
	• Working with KEBS to develop standards for avocado paste • Linking farmers to credit facility providers to get capital to engage in avocado paste production agribusiness.
Lessons learned in upscaling, if any	Not yet. It is a new technology

Social, environmental, policy and market conditions necessary for development and upscaling	• 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 avocado paste to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Paste pulper, pasteurizer and packaging equipment are the main cost items
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado paste
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge • VMGs may have limited access to productive resources such as land, credit, and quality seed • VMGs may 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	• Opportunity to produce, trade in, and consume locally produced avocado paste products
E: Case studies/profiles of success stories	
Success stories	No documentation accessed
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1=Ready for upscaling, 2=requires validation, 3=requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director
	Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.

Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

2.9.4 Avocado Sauce

2.9.4 TIMP name	**Avocado Sauce**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado high postharvest losses due to high perishability, and low market prices
What is it? (TIMP description)	Avocado sauce is processed by blending ripe avocado with sour cream, lime sauce and garlic.  *Avocado sauce* (*source:* fruitprocessing.com)
Justification	Diversification of avocado food products will enhance consumption of avocado, and demand thus spur increased production. avocado can be processed to make avocado sauce which is consumed with otheraccompaniments like chips
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado sauce • Availability of quality avocado sauce standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado sauce production technology • KEBS – Standards formulation for avocado sauce certification of private avocado oil processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado sauce • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	Limited awareness of the technology by farmers
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 • Working with KEBS to develop standards for avocado sauce • Linking farmers to credit facility providers to get capital to engage in avocado sauce production agribusiness.
Lessons learned in upscaling, if any	None, it is a new innovation
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 avocado sauce to propel its commercialization

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Blender and packaging equipment
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado sauce
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 related opportunities	• Opportunity to produce, trade in, and consume locally produced avocado sauce products • The VMGs can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	None, it is a new innovation
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1=Ready for upscaling, 2=requires validation, 3=requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT

	• Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

2.9.5 Canned avocado

2.9.5 TIMP name	Canned avocado
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado, high postharvest losses due to high perishability, and low market prices
What is it? (TIMP description)	Canned avocado is prepared from ripe avocado. It's made by cutting the avocado into desired shapes, boiling for three minutes, then packing in hot jars leaving 1-inch head space.  *Canned avocado* (source:fruitprocessing.com)
Justification	Diversification of avocado food products will enhance consumption of avocado, and demand thus spur increased production. avocado can be processed to make avocado canned which is consumed as a snack
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado canned • Availability of quality canned avocado standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado canned production technology • KEBS – Standards formulation for avocado canned , certification of private avocado oil processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado canned • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None. It is a new innovation
Counties where TIMPs will be upscaled	Murang'a, Kirinyaga, Meru and NandiMeru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in dissemination	Limited awareness of the technology by farmers
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 • Working with KEBS to develop standards for avocado canned • Linking farmers to credit facility providers to get capital to engage in avocado canned production agribusiness.
Lessons learned in upscaling, if any	None. It is a new innovation
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 avocado canned to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Canning machine and packaging equipment
Estimated returns	Increased sales and hence income, enhanced nutrition status from

	increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado canned product
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge • VMGs may 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	• Opportunity to produce, trade in, and consume locally produced avocado canned products • The VMGs can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	No documentation accessed. It is a new innovation
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Further research
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.)

	• Hotels, restaurants, food processing companies • Exporters • HCDA

2.9.6 Frozen Avocado

2.9.6 TIMP name	Frozen Avocado
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado, losses due to poor postharvest management
What is it? (TIMP description)	Frozen avocado are ripe avocado which are cut into small chunks, lemon paste added, sealed tightly in plastic container to minimize browning and can keep for 4-6 months in a freezer.  *Frozen avocado chunks* (*Source:* fruitprocessing.com)
Justification	Diversification of avocado food products will enhance consumption of avocado, and demand thus spur increased production. Avocado can be processed to make frozen avocado chunks which are consumed as snacks.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks

	• Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality frozen avocado chunks • Availability of quality frozen avocado chunks standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of frozen avocado chunks production technology • KEBS – Standards formulation for frozen avocado chunks, certification of private avocado pulp processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the frozen avocado chunks • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None. It is to be newly introduced
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	Limited awareness of the technology by farmers
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 • Working with KEBS to develop standards for avocado frozen chunks • Linking farmers to credit facility providers to get capital to engage in frozen avocado chunks production agribusiness.
Lessons learned in upscaling, if any	None.
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 frozen avocado chunks to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Slicing equipment and right size/type freezer are the main cost items
Estimated returns	Increased sales and hence income, enhanced nutrition status from

	increased consumption of avocado
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of frozen avocado chunks
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge • VMGs may 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	• Opportunity to produce, trade in, and consume locally produced frozen avocado chunks based products • The VMGs diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	No documentation accessed. It is a new innovation
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI),

	Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

2.9.7 Avocado stone flour

2.9.7 TIMP name	**Avocado stone flour**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado stone, losses due to postharvest losses
What is it? (TIMP description)	Flour prepared from milling avocado stone  *Avocado flour*
Justification	Diversification of avocado food products will enhance consumption of avocado and its demand, thus leading to increased production. Avocado stone can be processed to make flour, which can either be fortified or blended with wheat to make various products including *mandazi* and, *bread,* among others. Use of avocado stone flour will improve the human nutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks, • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado seed flour, • Availability of quality avocado seed flour standards
Partners/stakeholders for scaling up and their roles	• MoALD will work with the farmers to provide technical extension services. • Counties facilitate the extension and other support such as transport to the staff as well as being a channel for provision of grants to the farmers. • CIGs play the role of adoption of the technologies through their various groups. • VMGs will benefit from the grants as they adopt the technologies. They are the recipients of the technologies. • Farmer groups – provide land for establishment of small-scale avocado seed flour processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado seed flour production technology • KEBS – Standards formulation for avocado seed flour, certification of private avocado flour processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado seed flour • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Not yet
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of the technology by farmers • Lack of knowledge on edibility of the avocado stone
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

	avocado, focusing on the nutritional quality of avocado (rich in minerals). • Working with KEBS to develop standards for avocado seed flour • Linking farmers to credit facility providers to get capital to engage in avocado seed flour production agribusiness.
Lessons learned in upscaling, if any	Not yet
Social, environmental, policy and market conditions necessary for development and Upscaling	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 avocado seed flour to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Drying, milling, packaging equipment and labour
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in marketing avocado seed flour hence earn more income
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 related opportunities	• Opportunity to produce, trade in, and consume locally produced avocado seed flour based products • Nutritious products can be made from avocado seed flour contributing to the nutrition of VMGs.
E: Case studies/profiles of success stories	
Success stories	None accessed
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos

F: Status of TIMP readiness (1=Ready for upscaling, 2=requires validation, 3=requires further research)	Further Research
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters

2.9.8 Avocado Cake

2.9.8 TIMP name	**Avocado Cake**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado,high postharvest losses due to high perishability, and low market prices
What is it? (TIMP description)	A snack food product made from avocado-wheat composite flour
	 *Avocado cake* (Source: *fruitprocessing.com*)
Justification	Diversification of avocado food products will enhance consumption of avocado and demand, thus spurring increased production. Avocado can be processed to make avocado cake which is consumed as a snack
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado cake • Availability of quality avocado cake standards
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado cake production technology • KEBS – Standards formulation for avocado cake, certification of private avocado oil processors • Private sector processors • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the avocado cake • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	None.
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Limited awareness of the technology by farmers
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 • Working with KEBS to develop standards for avocado cake • Linking farmers to credit facility providers to get capital to engage in avocado cake production agribusiness.
Lessons learned in upscaling,	Not yet

if any	
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 avocado cake to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cake pulper, cakeurizer and packaging equipment are main cost items
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado cake
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 related opportunities	• Opportunity to produce, trade in, and consume locally produced avocado cake products
E: Case studies/profiles of success stories	
Success stories	None accessed
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1=Ready for upscaling, 2=Requires validation, 3=Requires further research)	Requires Validation
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.

Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT • Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

GAPS

- Further research on cake

2.9.9 Avocado Chapatti

2.9.9 TIMP name	**Avocado Chapatti**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Limited utilisation of avocado ,high postharvest losses due to high perishability, and low market prices
`	Avocado chapati is prepared from dried and milled avocado stone. It's made by blending avocado flour with wheat flour, mixing with warm water and salt, then cooked on a medium heat using oil.  *Avocado blended chapati*
Justification	Diversification of avocado food products will enhance consumption of avocado, and demand thus spur increased production. Avocado stone flour can be processed to make avocado chapatti which is consumed as a snack
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, industrial and commercial 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	• Participatory implementation, stakeholder capacity building and networks • Promotions involving Public Private Partnerships (PPP) • Increased production of high-quality avocado chapatti
Partners/stakeholders for scaling up and their roles	• Farmer groups – provide land for establishment of small-scale avocado processing facility • Extension service providers (Public and private) to help in the dissemination • KALRO – will train trainers and provide technical backstopping on dissemination of avocado chapatti production technology • Private sector processors • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Not yet
Counties where TIMPs will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	Limited awareness of the technology by farmers
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 • Working with KEBS to develop standards for avocado chapatti • Linking farmers to credit facility providers to get capital to engage in avocado chapati production agribusiness.
Lessons learned in upscaling, if any	Not yet
Social, environmental, policy and market conditions necessary for development and upscaling	• 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 avocado

	chapati to propel its commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Flour to blend, Nonstick pan, rolling stick equipment are the main cost items
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of avocado
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may not have access to resources required for adoption of the enterprise • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge • Women and youth may not be principal decision makers at the household and community levels
Gender related opportunities	• Women and youth stand to benefit in production, use and sale of avocado chapatti
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 related opportunities	• Opportunity to produce, trade in, and consume locally produced avocado chappati products
E: Case studies/profiles of success stories	
Success stories	No documentation accessed. It is a new innovation
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
F: Status of TIMP readiness (1=Ready for upscaling, 2=requires validation, 3=requires further research)	Requires validation
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.
Lead organization and scientists	KALRO J. Ndambuki (KALRO-Muguga), C. Gathambiri (KALRO-HRI), F. Wayua (KALRO-Kakamega), V. Kirigua and L.Wasilwa (KALRO-HQ).
Partner organizations	• Ministry of Agriculture (County Governments) • JKUAT

	• Egerton University • CBOs and NGOs (e.g. Farm Concern International (FCI), Twiga Foods Ltd.) • Hotels, restaurants, food processing companies • Exporters • HCDA

GAPS

1. Identify market demand for the products
2. Establishing gross margin of the value added avocado products

2.10 Mechanization of Avocado Production Activities

2.10.1 Boom mouned mulcher

2.10.1 TIMP Name	**Boom mounted mulcher**
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 Avocado commodity • Reduced capacity due to manual digging drudgery • High cost of manual labour
What is it? (TIMP description)	• Boom mounted mulcher for PTO (Power take off) drive tractors, highly efficient for mulching in ditches, on slopes and along roadsides for uneven ground to plant tree fruits. • Because of their extremely robust construction and user friendly features, it's possible to use this machine in mulching mower in forested, thicketed and bushy land. • All critical components are made of special steel: extreme durability with minimum weight. • The machine can be fitted with a forestry mulching head Intelligent control, high power at the mulching head and an extremely robust design that can mulch up to 155 cm width in one pass. • Thanks to its ergonomic joystick operation and the exclusive EHS system (Electronic Head Suspension) which adapts the

	mulching head automatically to the contours of the ground it achieves driving speeds. • This allows the operator to quickly react to sudden obstacles and maximize his productivity.
Justification	It has multiple uses and other advantages.A Boom mounted mulcher can be used in tree seedbed preparation through cutting and burying the trash for decomposition. A power Tiller is ideal where the land size is small.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado farmers and researchers, agripreneurs
Approaches 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 adopt if appropriate • A platform for interaction of Avocado 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of appropriate machines for different farm activities • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Establish Avocado innovation platforms • Acquisition of the machines • Avail facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in upscaling 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 upscaling	• 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 7,000,000. The small scale farmers they ca hire the services at negotiated costs
Estimated returns	KES 300,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work • Women and youth have limited access credit to purchase the required implements • Women and youth have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor • 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 employing VMGs along the operations using the mulcher
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	1. Demonstrations and training 2. User manuals
F: Status of TIMP readiness (1=ready for upscaling 2=requires validation; 3=requires further research**)**	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators

2.10.2 Pole saw

2.10.2 TIMP Name	Pole saw
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 bush clearing and pruning, in a commercialized Avocado commodity • Reduced capacity due to manual digging drudgery • High cost of manual labour
What is it? (TIMP description)	• A dielectric pole saw for professionals. • The saw delivers an extra measure of safety for skilled line workers, utility workers, and tree care professionals. • The saw can be used in the bucket, in the tree, or on the ground for extreme versatility. • Purposeful design allows the pole saw's sections to quickly disconnect for secure storage in a tree care truck or utility vehicle. • More productive than a manual saw and more useful than a hydraulic unit, makes pruning and limbing projects more efficient than ever before.
Justification	It has multiple uses and other advantages including being light. It can be used in tree pruning and bush clearing. A power Tiller is ideal where the land size is small. Farm sizes less than one hectare may limit maneuverability.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado farmers, researchers and agripreneurs
Approaches 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	• Applied and adaptive Research to test, validate and adopt if appropriate

promotion	• A platform for interaction of Avocado 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of appropriate machines for different farm activities • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Establish Avocado innovation platforms • Acquisition of the machines • Avail facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in upscaling 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 upscaling	• 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 7,000,000 for tractor; hiring @ KES 3000 per acre for ploughing
Estimated returns	KES 300,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth may have limited access credit to purchase the required implements • Women and youth may have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor • 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 VMGs able to operate the implement
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	1. Demonstrations and training 2. User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators

2.10.3 Harrow

2.10.3 TIMP Name	**Harrow**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Avocado 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, and cover seed.It is used primarily for breaking up and smoothing the soil in preparation of a seedbed for small sized grain planting.
Justification	• Creating of a crumbly layer for planting is tedious. • It is not possible to manually protect the soil surface from rapid drying but with this harrow, it can be done. • 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 • Machine land harrowing Improves nutrient availability to plants. • Enables intercropping in avocado plantation to maximize space utility
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado farmers, researchers, agripreneurs
Approaches 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 Avocado varieties • A platform for interaction of Avocado 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.

Challenges in dissemination	• Lack of Avocado 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 Avocado 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 upscaling 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 upscaling	• 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 for the Harrow. If hiring @ KES 3000 per acre together with the tractor
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work • Women and youth have limited access credit to purchase the required implements • Women and youth have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor • 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 VMGs in operating the implement
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	1. Demonstrations and training 2. User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.4 Tractor-operated Hole Auger

2.10.4 TIMP Name	**Tractor-operated Hole Auger**
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 hole digging increases the cost of making planting holes. It is slow and tedious processes. It is also difficult to prepare a uniformly spaced contour ridges. Delayed operation lead to late planting. Manual hole digging increases the cost of hole making.
What is it? (TIMP description)	• Hole digger is a Tractor PTO driven machine that digs holes in rows at equal depths mechanically and economically. • It also can be used for hole making for electric poles and farm hedges. • It is best suited for tree plantation. • It can dig about 90 cm deep hole even diameter in just 30 seconds. • By detaching augers, it can be used as a small crane
Justification	The auger digs a definite hole diameters and depths as desired.

	Users spend a short time to make the holes. The machine spends low amounts of fuel. It is easy to use, and can be used to a much greater depth, as the hole can be dug as deep as the entire length of the shaft. It mechanically removes soil from holes. The machine form a much neater hole, with a well-defined circumference. Holes can be made at pre-defined places by driving the compact tractor. Size of the hole is determined by the size of the auger used.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado farmers, researchers, agripreneurs
Approaches 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 Avocado varieties • A platform for interaction of Avocado 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of Avocado 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 Avocado 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 upscaling 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 upscaling	• 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) The small scale farmers they can hire the services at negotiated costs
Estimated returns	KES 20,000 per month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work • Women and youth have limited access credit to purchase the required implements • Women and youth have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employmentopportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor • 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 in operating the implement
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	1. Demonstrations and training 2. 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 Nasirembe W,
Partner organizations and contacts	Local Fabricators

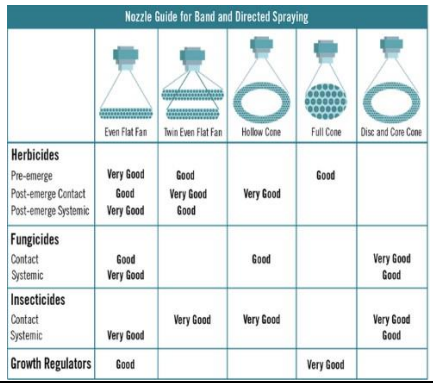
2.10.5 Portable Hand-Operated hole Auger

2.10.5 TIMP Name	**Portable Hand Operated hole Auger**
Category (technology, innovation or management practice)	Innovation 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• High and increasing cost of manual labour. • Manual hole digging increases the cost of making planting holes. • It is slow and tedious processes. • It is also difficult to prepare a uniformly spaced contour ridges. • Delayed operation lead to late planting. • Manual hole digging increases the cost of hole making.
What is it? (TIMP description)	• A Portable Hand Operated Earth Auger for Tree Planting is a machine that digs holes in rows at equal depths mechanically and economically. • It also can be used for hole making for electric poles and farm hedges. • It is best suited for tree plantation. • It can dig about 90cm deep hole even diameter in just 30 seconds. • By detaching augers, it can be used as a small crane.
Justification	• The auger digs a definite hole diameters and depths as desired. • Users spend a short time to make the holes. • The machine spends low amounts of fuel. • It is easy to use, and can be used to a much greater depth, as the hole can be dug as deep as the entire length of the shaft. • It mechanically removes soil from holes. • The machine forms a much neat hole, with a well-defined circumference. • Holes can be made at pre-defined places by driving the compact tractor.

	• Size of the hole is determined by the size of the auger used.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado farmers and researchers
Approaches 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 Avocado varieties • A platform for interaction of Avocado 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	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of Avocado 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 Avocado 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 upscaling 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 upscaling	• 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 perform most of the crop production activities, therefore the implement will reduce their drudgery of work • Women and youth have limited access credit to purchase the required implements • Women and youth have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor • 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 in operating the implement
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	1. Demonstrations and training 2. 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 Nasirembe W,
Partner organizations and contacts	Local Fabricators

2.10.6 Motorised Sprayer

2.10.6 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 avocado. The height of the tree requires a long projectile spray; Avocado 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. Motorized sprayers can be portable units typically backpacks with spray guns. It can be used to spray a liquid e.g. where sprayers are commonly used for projection of water, herbicides and crop performance enhancement materials, pesticides.
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before Avocado forms a canopy, broad leafed weeds compete with Avocado seedling for nutrients and light greatly reducing their yield. Manual sprayers are labour intensive and spraying labour is too expensive.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado Farmers and agribusiness entrepreneurs
Approaches 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 Avocado varieties • A platform for interaction of Avocado value chain stakeholders • Acceptance by Farmers
Partners/stakeholders for	Machinery fabricators

scaling up and their roles	NGO supporting farmers(AGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of Avocado 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 Avocado innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign using various channels including demonstrations and trainings
Lessons learned in upscaling 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 upscaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on value of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer KES 55,000 per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the planting activities; therefore the implement will reduce their drudgery of work when available • Women have less access to farm implements such as the motorized sprayer than men • Women and youth have limited access credit to purchase the required chemicals • Women and youth have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to farm implements such as the motorized sprayer than men • VMGs have limited access credit to purchase the required chemicals

	• VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities exist for unemployed youth in operating the implement
E: Case studies/profiles of success stories	None accessed
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	1. Demonstrations and training 2. User manuals
F: Status of TIMP readiness 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 Nasirembe W,
Partner organizations and contacts	Local Fabricators

2.10.7 Grafting robot

2.10.7 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 Avocado grafted planting material • High cost of labour • Manual labour is diminishing • Slowness in manual Avocado seedlings grafting
What is it? (TIMP description)	

Justification	• The machine works faster • The machine is consistent in cut angle • The cutting blades are automatically disinfected after each cycle • Allows grafting of small plants • Cost effective
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado Farmers and agribusiness entrepreneurs
Approaches 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 Avocado varieties • A platform for interaction of Avocado value chain stakeholders • Acceptance by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be upscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	Lack of Avocado innovation platforms to facilitate interaction of farmers with relevant stakeholders
Suggestions for addressing the challenges	• Establish Avocado innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in upscaling 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 upscaling	• 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	• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work • Women and youth have limited access credit to purchase the required implements • Women and youth have limited access to education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase the implement • 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
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	1. Demonstrations and training 2. User manuals
F: Status of TIMP readiness (1=ready for up- scaling; 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	
Partner organizations and contacts	Tecsols Ltd – Nakuru

2.10.8 Towable boom lift harvesting machine

2.10.8 TIMP Name	**Towable boom lift harvesting machine**

Category: Technology	
A: Description of the technology, innovation or management practice	
Problem to be addressed	• High cost of manual labour • Scarcity of manual labour
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	• Use of the machine quickens the work • The machine is telescopic and can reach far end branches • Can be attached to a tractor that uses gasoline as fuel • Discourages child labour • Cost effective
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Avocado Farmers and agribusiness entrepreneurs
Approaches 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 Avocado varieties • A platform for interaction of Avocado value chain stakeholders • Acceptance by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers

C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Trans Nzoia, Nandi, Bomet, Uasin Gishu, Nyeri, Murang'a, Narok, Nakuru, Nandi, Narok, Embu
Counties where TIMP will be upscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in dissemination	• Lack of Avocado 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 Avocado innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in upscaling 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 upscaling	• 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	Avocado harvester KES 125,000 per unit.
Estimated returns	Requires only one season to return the KES 125,000 purchase price when contracts are available
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work • Women and youth have limited access credit to purchase the required implements • Women and youth may have limited access to education, training and extension services than men • Women may have less access to agricultural information, technology and knowledge
Gender related opportunities	• Employment opportunities exist for youth in operating the implement
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase the implement • 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 VMGs in operating the implement
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	1. Demonstrations and training 2. User manuals
F: Status of TIMP readiness **(**1=ready for up-scaling; 2=requires validation; 3=requires further research**)**	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W,
Partner organizations	Local Fabricators
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W Egerton University,
Partner organizations	Tecsols Ltd – Nakuru

2.11 Agricultural Business and Marketing

2.11.1 Models for market-oriented production of avocado

2.11.1 TIMP Name	**Models for market-oriented production of avocado**
Category innovation practice) (i.e. or technology, management	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low commercialization of avocado production
What is it? (TIMP description)	An approach to organize avocado production based on market orientation using models. Producer–driven model is based on production organized by the producers themselves. Buyer-driven model is based on production organized by the customers or companies. Intermediary- driven model 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 avocado production. Farmers should have markets, 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
Critical/essential factors for successful promotion	• Acceptance of smallholder farmers to produce avocados • Availability of investors • Good prices of avocado • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – investments in avocado 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 avocado production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMPs will be upscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Group dynamics • Limited investment by buyers • Low prices of avocado • Lack of enabling 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 avocado – Setting minimum price • Policy support – price policy, subsidies, inputs support
Lessons learned in upscaling if any	• Production of avocado 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 ,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-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate • Women's status, age, wealth level may influence participation • Limited access to assets, resources and services, required to join producer groups • In some cultures women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirementsof producers' organizations may limit women participation
Gender related opportunities	• Youth stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs are widely discriminated in rural producer organizations • 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	• VMGs stand to benefit with higher profit margins through collective bargaining and marketing • Opportunities exist for unemployed VMGs in production and marketing e.g. through use of ICT

E: Case studies/profiles of success stories	
Success stories from previous similar projects	Not yet documented
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1= Ready for upscaling, 2=Requires validation, 3= Requires further research)	The models are ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

2.11.2 Developing a Business Plan for avocado farm

2.11.2 TIMP Name	**Developing a Business Plan for avocado farm**
Category (i.e. technology, Innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low management and lack of sustainability and success in avocado farming due to lack of business plans.
What is it? (TIMP description)	A avocado business plan will serve as an internal management and organizing tool that can be used to communicate both within and outside your business.
Justification	With a business plan in hand, avocado farmers and rural entrepreneurs will be able to take 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-Elecronic and print
Critical/essential factors for successful promotion	• Education levels of the farmers and investors in avocado production • Levels of experiences in avocado production • Availability of information on avocado production and marketing

	• Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by 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 avocado • Research institutions – Capacity building • Financial Institutions – Financial support
C: Current situation and future scaling up	
Counties where already promoted if any	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMPs will beupscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on avocado production and marketing • Low levels of policy support • Low levels of education
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the avocado production – Developing information hub • Low level of policy support – support in extension services • Low levels of education – Capacity building
Lessons learned in upscaling if any	• Low adoption of business planning by the farming community
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Acceptable in Counties growing avocado • 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, 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-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate

	• Women's status, age, wealth level may influence participation • Limited access to assets, resources and services, required to join producer groups • In some cultures women may not be able to travel away from their homes to producer group meetings, without permission • Strict rulesof entry and requirements of producers' organizations may limit women participation
Gender related opportunities	Youth stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• Some are illiterate hence cannot keep good records
VMG related opportunities	Those V M G s recovering from drug abuse and HIVs, if they exist, have an opportunity to venture in this enterprise
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1= Ready for upscaling, 2=Requires validation, 3= Requires further research)	The matrices are ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

1 Impact of business plan on avocado production
2 Adoption of business plan

2.11.3 Marketing as a group - collective marketing

2.11.3 TIMP Name	**Marketing as a group - 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 limits accessibility to good markets and realization of good returns due to low volumes and low prices

What is it? (TIMP description)	Marketing as a group is a collective marketing approach. It involves formation of a group of farmers with an objective of increasing market accessibility.
Justification	Due to small-scale farming of avocado, marketing as a group would enable farmers to gain from economies of scale. The advantages of collective marketing are bigger volumes traded, uniform quality, reliable sellers, reliable buyers, continuous supply, higher price and good organization
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-Elecronic and print •
Critical/essential factors for successful promotion	• Production programme outlined • The farmer is not able to deliver the agreed amount to the group • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by 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	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMPs will be upscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on avocado production and marketing • Low 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 avocado production – Developing information hub • Low level of policy support – support in extension services
Lessons learned in upscaling if any	Volume target: low 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 avocado production • Policy conditions – need for infrastructural support
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 ,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-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate • Women's status, age, wealth level may influence participation • Limited access to assets, resources and services, required to join producer groups • In some cultures women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	Youth stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs are widely discriminated in rural producer organizations • 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	VMGs stand to benefit with higher profit margins through collective bargaining and marketing
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org

Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

1 Profitable opportunities
2 Performance of marketing as a group

2.11.4 Profitability analysis - Reviewing performance of avocado agro-enterprise

2.11.4 TIMP Name	**Profitability analysis - Reviewing performance of avocado 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
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the avocado agro-enterprise
Justification	Profitability analysis reviews the management success and sustainability of the avocado business. It enables identification of 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-Elecronic and print
Critical/essential factors for successful promotion	• Record keeping of costs and returns • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – record keeping • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	None

Counties where TIMPs will be upscaled	All counties producing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination -	• Inability of farmers to keep records • Use of non-costed family labour in avocado production
Suggestions for addressing the challenges	• Inability of farmers to keep records – capacity building • Use of non-costed family labour in avocado production – capacity building on how to cost family labour
Lessons learned in upscaling 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 avocado • Policy conditions – Policy support in moderation of production inputs costs and prices of produce • Market conditions – Higher prices than production costs
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, dissemination, adoption and scaling up	• Women bare widely discriminated in ruralproducer organizations • Women also have limited participation and influence in rural producer organizations • Socio-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate • Women's status, age, wealth level may influence participation • Limited access to assets, resources and services, required to join producer groups • In some cultures women may not be able to travel away from their homes to producer group meetings, without permission • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	Being a high value crop, opportunities exist for youth since they are highly literate and can be able to keep good records
VMG issues and concerns in development, sissemination, adoption and scaling up	Some are illiterate hence cannot keep good records
VMG related opportunities	Those youths recovering from drugs and HIVs have an opportunity to venture in this enterprise since they can be able to keep good farm record.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures

	3. Manuals 4. Power point slides 5. Videos
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina F.W., Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

- Investigation on strategies to reduce costs of production of avocado
- Investigation on price increasing strategies

2.11.5 Scaling up plan of avocado agro-enterprise development

2.11.5 TIMP Name	**Scaling up plan of avocado agro-enterprise development**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Inadequate capacity to meet quantity demanded by the market. This can be due to low capacity of production by farmers marketing the avocado individually or in groups.
What is it? (TIMP description)	This a plan for organizing farmers to be able to meet quantities targeted by the market. The plan is to increase the capacity of the groups by increasing group membership and/or incorporating more groups into avocado marketing. The plan involves managing more groups, training other facilitators, working with second-order associations and cooperatives, working with buyers, promoting innovation, enhancing communication and use of media
Justification	Farmers to have high scope of operation enabling them to reach lucrative and sustainable markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension agents, traders, processors, 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-Elecronic and print
Critical/essential factors for successful promotion	• Ability of farmers to increase production within their groups • Ability of aggregation of the produce (avocado) • Ability t o work with other existing groups • Possibility to form new groups • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by 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	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bommet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMPs will be upscaled	Avocado producing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 • Issues related to recruiting and incorporating new groups
Suggestions for addressing the challenges	• Farmers to ensure they meet their new production target from the group members and farmers investing in new technology to achieve new targets • The original group help new entrant farmers to develop an enterprise plan as agreed • Newly recruited groups to be embraced and facilitated to become compliant
Lessons learned in upscaling 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 marketing forrums

Estimated returns	• Good prices and high turnovers leading to increased income
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women are widely discriminated in agro-enterprise groups • Women also have limited participation and influence in agro- enterprise groups • Limited access to assets, resources and services, required to join agro-enterprise groups • In some cultures, women may not be able to travel away from their homes to agro-enterprise groups, without permission • Strict rules of entry and requirements of agro-enterprise groups' may limit women participation
Gender related opportunities	• Youths stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs are widely discriminated in agro-enterprise groups • VMGs also have limited participation and influence in agro-enterprise groups • Limited access to assets, resources and services, required to join agro-enterprise groups
VMG related opportunities	• VMGs stand to benefit with higher profit margins through collective bargaining and marketing • Opportunities exist for unemployed VMGs in production and marketing e.g. through use of ICT
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

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

2.11.6 Contracted Avocado production model

2.11.6. TIMP Name	Contracted Avocado 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 Avocado production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves 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 produce 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 produce, The contract can either be informal (oral) or formal (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 risks, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A formal (written) contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers,Traders,Extension agents. Research institutions. Farmer cooperatives, 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
Critical/essential factors for successful promotion	• Willing farmers • Availability of traders • Competitiveness of Avocado • Production volume/quantity • Enforcement of contract farming • Applied and adaptive Research to test, validate and

	release improved avocado varieties • A platform for interaction in avocado value chain by 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, release and availing improved avocado varieties
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be upscaled	All Counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination -	• Unorganized and scattered farmers • Small-scale farming • Lack of awareness and information by the potential producers • Lack of policy support
Suggestions for addressing the challenges	• Formation of production clusters • Increase volume through formation of producer groups and enhancing productivity • Capacity building • National and County policy formulation and enforcement for contract farming
Lessons learned in upscaling if any	• Increased benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming • Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, input support in the contract improves natural resource management • Policy conditions – formulation of enabling policies and enforcement • Market conditions – ensuring agreed contract volumes within specified place and time.
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 ,dissemination, adoption and scaling up	• Women are widely discriminated in rura producer organizations • Women also have limited participation and influence in rural producer organizations • Socio-cultural norms may limit women's participation and

	leadership in groups • Women's double and triple roles means they may not have time to participate • Women's status, age, wealth level may influence participation • Limited access to assets, resources and services, required to join producer groups • In some cultures women may not be able to travel away from their homes to producer group meetings, without permission • Strict rulesof entry and requirements of producers' organizations may limit women participation
Gender related opportunities	• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit • Margins
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to knowledge and information on contract farming • VMGs have less access to land for farming
VMG related opportunities	• Opportunities exist for VMGs to enter into contract farming and make profits to increase income
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Brochures 3. Manuals 4. Power point slides 5. Videos
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

Gaps for further research

- Assessment of performance of contracted farming in terms of productivity, sales and profit
- Equity distribution

2.11.7 Avocado marketing entrepreneurship model

2.11.7. TIMP Name	Avocado marketing entrepreneurship model
Category (i.e. technology, Innovation ormanagement practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Farmers failure to apply entrepreneurship while marketing avocados leading to low prices
What is it? (TIMP description)	An entrepreneur farmer undertakes innovations and business acumen in an effort to transform the innovations into economic goods and ultimately make profit.
Justification	Farmers become entrepreneurs when business principles are applied in farming practices to make businesses successful. Failure to apply business principles farming business would not be successful.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Extension agents. Research institutions. Farmer cooperatives, 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-Elecronic and print
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 avocado varieties • A platform for interaction in avocado value chain by 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 upscaled	All Counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu,

	Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira.
Challenges in development and dissemination	• Small-scale farming • Availability of information • Profitability in Avocado farming • Lack of policy support
Suggestions for addressing the challenges	• Capacity building to farmers • Scanty availability of information on innovations • Weak or lack of County policy support
Lessons learned in upscaling 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, dissemination, adoption and scaling up	• Women may lack entrepreneurial skills and capacity to engage in entrepreneurship compared with men • Women may lack knowledge to save their money that can be used in entrepreneurship • Women do not usually apply for loans that can be used to 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, dissemination, adoption and scaling up	• VMGs may lack basic reading and numeracy skills so they can run their businesses compared with men • VMGs may lack the business acumen compared with men • VMGs may lack the starting capital
VMG related opportunities	• Opportunities exist for VMGs to venture in entrepreneurship through affirmative action funds that are given to them e.g. • Uwezo fund, .
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Ready for upscaling
F: Status of TIMP Readiness (1= Ready for upscaling, 2,=Requires validation, 3= Requires further research)	Available innovations are ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M., Njuguna J.K and GathambiriC.

Partner organizations	FPEAK, NGOs

Gaps for further research

1 Sustainability based on market prices
2 Innovations for increased productivity

2.11.8 Internet/online/mobile marketing

2.11.8. TIMP Name	**Internet/online/mobile marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor market access due to constraints in marketing channels, skills and market information
What is it? (TIMP description)	Internet marketing refers to the strategies used to market products and services online and through other digital means. These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet marketing is increasingly becoming important and mandatory for businesses of all types. Thus adaptability to internet marketing is an important venture 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. Research institutions. Farmer cooperatives, 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-Elecronic and print
Critical/essential factors for successful promotion	• Education levels of the farmers and investors in Avocado production • Profitability analysis of the ventures • Availability of information on Avocado production and marketing • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by stakeholders • Availability of internet
Partners/stakeholdersfor scaling up and their roles	• Farmers – Sellers of Avocado production • County extension staff - Capacity building

	• NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of Avocado • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties wherealready promoted if any	None
Counties where TIMPs will be upscaled	Counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 Avocado production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	• Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the Avocado production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in upscaling 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 ,dissemination, adoption and scaling up	• Women have less access to the required tools such as phones and computer than men • Women could be more illiterate and therefore may not use the ICTs as would be expected
Gender related opportunities	• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have access to smart

	phones.and internet
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to the required tools such as phones and computer than men • VMGs could have literacy challenges and therefore cannot use the ICTs platforms as desired
VMG related opportunities	• Opportunities exist for VMGs to use the ICT tools if they have the appropriate skills.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: Factsheets, Manuals Power point slides
F: Status of TIMP Readiness (1=Ready for upscaling, 2=Requires validation, 3=Requires further research)	The platforms are ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

Gaps for further research

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

2.12 Agricultural Policy Options

2.12.1 National Agricultural policy framework for smallholder Avocado producers

2.12.1. TIMP Name	**National Agricultural policy framework for smallholder Avocado producers**
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' knowledge 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, Policy makers, 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-Elecronic and print
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of specific Avocados-based policies • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Avocados policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Avocados 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	Murang'a, Nandi, Kiambu, Nyeri, Kirinyaga, Meru, Bomet, Narok, Kitale, Bungoma, Nakuru, Kisii
Counties where TIMPs will be upscaled	All counties growing avocado including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, Narok, Machakos, Uasin Gishu, Vihiga, Nyamira
Challenges in development and dissemination -	• **Value Chain**: Avocado 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 Avocados production, wherein many farmers abandoned Avocados production. These weak organizations provide few services to farmers while providing limited bargaining power. • **Financial Incentives**: The government provides only limited support to Avocados 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 Avocados 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 Avocados 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 Avocados 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 upscaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Traditional farming of Avocados where there is no value chain • Environmental conditions – Use of pesticides

	• Policy conditions – Lacking specific Avocado 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 ,dissemination, adoption and scaling up	• Inadequate representation of youth and women in policy development forums at all levels • Inadequate representation of youth and women in the policy validation process
Gender related opportunities	Opportunities exist for adequate youth and women representation in the policy formulation and validation process if they focus and strategize well
VMG issues and concerns in development, dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels • Inadequate representation of VMGs in the policy validation process
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
F: Status of TIMP Readiness (= Ready for upscaling, 2= Requires validation, 3=Requires further esearch)	Requires validation and up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

Gaps for further research

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

2.12.2 Policy options and objectives related to Avocado farming

2.12.2 TIMP Name	Policy options and objectives related to Avocado farming
Category (i.e. technology, Innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Market failure in influencing the behaviour in Avocado production and marketing due to lack of enabling policies
What is it? (TIMP description)	A policy towards the agricultural sector as a whole, or towards one particular interest group such as food consumers, grain producers, Avocado producers or fertilizer manufacturers can be characterized as consisting of three sets of elements; objectives, instruments of policy and rules for operating instruments of policy.
Justification	Agricultural policies for supporting Avocado production address farm to market and finally consumption issues. The policy objective is to increase Avocado production. The policy instruments chosen may be to raise the price of Avocado received by producers, such as an import tax or a production subsidy. It may also be an instrument to reduce the cost of production such as an input subsidy or capital grant. It may as well be an instrument which reduces returns to products which compete Avocado for land, thus causing substitution of resources into Avocado production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Policy makers, 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-Elecronic and print
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of agricultural policies and specific Avocado-based policies • Issues in Avocado business • Specific policy objective statement • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Avocado policies to support production and marketing • County extension staff - Sensitization of farmers

	• NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Avocado 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 upscaled	Avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 Avocado value chain • Avocado production are specific to agro-ecological zones and not all the Counties in Kenya grow Avocado
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 Avocado value chain – strengthening Avocado value chain • Avocado production is specific to agro-ecological zones and not all the Counties in Kenya grow Avocado – Diversification of Avocado
Lessons learned in upscaling 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 Avocado 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 ,dissemination, adoption and scaling up	• Inadequate representation of youth and women in policy development forums at all levels • Inadequate representation of youth and women in the policy ovalidation process
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and • strategize well

VMG issues and concerns in development, dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels • Inadequate representation of VMGs in the policy of validation process
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

1 Adoption of policy options
2 Equity distribution among the stakeholders
3 Productivity levels among the smallholder farmers

2.12.3 Instruments of policy related to Avocado

2.12.3 TIMP Name	**Instruments of policy related to Avocado**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Failure to achieve policy objectives due lack of instruments related to the smallholder farmers' agency
What is it? (TIMP description)	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, Policy makers, Traders, Processing industries, Extension, NGOs, Research institutions, Agripreneurs
Approaches to be use 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-Elecronic and print
Critical/essential factors for successful promotion	• Availability of policy objectives • Availability of policy instruments • Applied and adaptive Research to test, validate and release improved avocado varieties • A platform for interaction in avocado value chain by 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 promotedif any	None
Counties where TIMPs will be upscaled	Avocado growing counties including Meru, Nyeri, Kirinyaga, Kisii, Muranga, Bomet, Bungoma, Embu, Kakamega, Kericho, Kiambu, Nandi, 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 Avocado value chain • Avocado production are specific to agro-ecological zones and not all the Counties in Kenya grow Avocado
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 Avocado value chain – strengthening Avocado value chain Avocado production are specific to agro-ecological zones and not all the Counties in Kenya grow Avocado – Diversification of • Avocado

Lessons learned in upscaling if any	• None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Low understanding of policy instruments • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Avocado 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, dissemination, adoption and scaling up	• Inadequate representation of youth and women in policy development forums at all levels • Inadequate representation of youth and women in the policy of validation process
Gender related opportunities	• Opportunities exist for adequate youth and women representation in the policy formulation and validation process if they focus and • strategize well
VMG issues and concerns in development, dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels • Inadequate representation of VMGs in the policy validation process
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Available from KALRO: 1. Factsheets, 2. Manuals 3. Power point slides
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina FW, Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

1 Validation of policy instruments
2 Equity distribution among the stakeholders

3 Farmer accessibility to production inputs markets
4 Farmers accessibility to output markets

2.12.4 Policy cycle for smallholders' policy issues and implementation

2.12.4 TIMP Name	**Policy cycle for smallholders' policy issues and implementation**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of policy development guidelines to handle emergence of challenges in avocado production, processing, value addition and consumption continuum.
What is it? (TIMP description)	Policy cycle is a tool which divides complex procedures into convenient and manageable steps in new policy development. These individual steps provide a frame work and antedates any forthcoming issues related to new policy development. The policy cycle is usually divided into four stages: agenda setting, formulation, implementation and evaluation
Justification	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. These policy cycle 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 • Agriprenuers • Processing industries • Consumer organizations • Extension service • NGOs • Research institutions
Approaches to be used in dissemination	• Meetings • Mass media – Electronic and print • Digital Platforms – Website, Dashboards, Apps, social media short message servicesFarmer field and business Schools(FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	• Availability of stakeholders • Identification of a policy gap and willingness to find solutions. • A platform for interaction in avocado value chain

	stakeholders • Financial resources for meetings and carrying out actions required
Partners/stakeholders for scaling up and their roles	• Farmers– generate issues • Private sector (local traders and exporters) – generate issues • County extension staff - capacity building • NGOs – capacity building and resource mobilization • Research institutions – capacity building • Policy makers-development, review, utilization and enforcing policies
C: Current situation and future scaling up	
Counties where already promoted if any	None, this is a new management practice
Counties where TIMPs will be upscaled	Avocado 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 who are mostly small scale • Inadequate information to stakeholders on policy gaps Poorly established avocado value chain.
Suggestions for addressing the challenges	• Disorganization and scattered farmers –formation of producer organizations as an institution and aggregation • Inadequate information to stakeholders – Sensitization on the roles of each policy cycle stages • Poorly established Avocado value chain – strengthening Avocado value chain
Lessons learned in upscaling if any	None, this is a new management practice
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Different issues among the avocado producers • Environmental conditions – environmental challenges • Policy conditions – Lacking specific avocado policy • Market conditions – Market challenges
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• To be determined. .
Estimated returns	• To be established
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Inadequate representation of youth and women in policy development forums at all levels • Inadequate representation of youth and women in the policy of validation process
Gender related opportunities	Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well
VMG issues and concerns in development, dissemination,	• Inadequate representation of VMGs in policy development forums at all levels

adoption and scaling up	• Inadequate representation of VMGs in the policy of validation process
VMG related opportunities	Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None, this is a new management practice
Application guidelines for users	Training factsheets, manuals and power point slides are available
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-HRI P.O. Box 220-1000 Thika Email: director.hri@kalro.org
Lead organization and scientists	Ndungu, J.M., Maina F.W, Wanyama M.
Partner organizations	FPEAK, NGOs

GAPS

Further research

1 Analysis of policy model
2 Impact on the new policies on avocado production and marketing

ANNEX 1: GROSS MARGIN ANALYSIS FOR AVOCADO PRODUCTION FOR SMALL & MEDIUM SIZED FARMS

Item	Unit	Year								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
No of fruits per tree	No of fruits	-	-	81	121	182	243	304	344	405
Total Marketable yield	No. of fruits	-	-	12,626	18,940	28,410	37,879	47,349	53,662	63,132
Grade 1 fruits Export market	No of fruits	-	-	7,576	11,364	17,046	22,728	28,410	32,197	37,879
Grade 11 Local market & oil processing	No of fruits	-	-	5,051	7,576	11,364	15,152	18,940	21,465	25,253
Price Grade 1 avocados	-	-	-	3	4	5	5	5	6	6
Income from Grade 1 export market	-	-	-	60,607	113,638	204,549	286,368	375,006	447,545	553,039
Price Grade 11 Avocado	-	-	-	2	2	2	2	2	2	3
Income from Grade 11 Local market & oil processing	-	-	-	25,253	37,879	62,501	83,335	113,638	128,790	164,144
Income from total marketable yield	-	-	-	85,860	151,518	267,050	369,703	488,644	576,335	717,183
Average selling price per piece	-	-	-	-	-	-	-	-	-	-
Gross Income	-	-	-	85,860	151,518	267,050	369,703	488,644	576,335	717,183
Inputs	-	-	-	-	-	-	-	-	-	-
Seedlings / trees	-	63	-	-	-	-	-	-	-	-
Manure	No.	2	2	2	2	2	2	4	4	4
Triple Super Phosphate	Tons	10	-	-	-	-	-	-	-	-
CAN	Kgs	10	15	15	19	25	32	38	45	51
NPK	Kgs	-	-	-	19	24	32	32	32	40
Murate of Potash	Kgs	-	-	-	-	-	16	16	16	20
Copper oxychloride	Kgs	-	-	0	1	1	1	1	1	2
Decis	Kgs	-	-	0	1	1	1	1	1	2
Land preparation	Litres	1	-	-	-	-	-	-	-	-
Hole preparation	Acres	63	-	-	-	-	-	-	-	-
Planting	No.	2	-	-	-	-	-	-	-	-
Irrigation	Mandays	39	39	39	39	39	39	39	39	39
Weeding and basins	Mandays	19	24	24	24	24	24	24	24	24
Spraying	Mandays	-	1	1	2	2	2	2	2	2

Item	Unit	Year								
		1	2	3	4	5	6	7	8	9
Pruning	Mandays	2	3	3	5	6	7	8	9	9
Topdressing	Mandays	-	0	0	1	1	1	1	1	1
Cost of seedlings / Unit	Man days	101	-	-	-	-	-	-	-	-
Cost of manure/ton	KES	1,416	1,416	1,416	1,416	1,416	1,416	1,416	1,416	1,416
Cost of TSP / kg	KES	28	28	28	28	28	28	28	28	28
Cost of CAN / kg	KES	18	16	16	16	16	16	16	16	16
Cost of NPK / kg	KES	24	24	24	24	24	24	24	24	24
Cost of Murate of Potash / kg	KES	101	101	101	101	101	101	101	101	101
Cost of Copper oxychloride/kg	KES	546	546	546	546	546	546	546	546	546
Cost of Decis / Litre	KES	1,012	1,012	1,012	1,012	1,012	1,012	1,012	1,012	1,012
Cost of land preparation/acre	KES	3,035	-	-	-	-	-	-	-	-
Cost of hole preparation/hole	KES	20	-	-	-	-	-	-	-	-
Cost of labour per day	KES	162	162	162	162	162	162	162	162	162
cost of Spraying	KES	162	162	162	162	162	162	162	162	162
Variable cost	KES	-	-	-	-	-	-	-	-	-
Seedlings	-	15,783	-	-	-	-	-	-	-	-
Manure	KES	6,657	6,657	6,657	8,499	8,499	8,499	14,164	14,164	14,164
Triple Super Phosphate	KES	666	-	-	-	-	-	-	-	-
CAN	KES	428	583	583	745	1,004	1,295	1,538	1,781	2,023
NPK	KES	-	-	-	1,117	1,457	1,943	1,943	1,943	2,428
Murate of Potash	KES	-	-	-	-	-	4,047	4,047	4,047	5,059
Copper oxychloride	KES	-	-	546	820	1,366	1,967	1,967	1,967	2,185
Decis	KES	-	-	1,012	1,518	2,023	3,035	3,035	3,035	4,047
Land preparation	KES	7,588	-	-	-	-	-	-	-	-
Hole preparation	KES	3,157	-	-	-	-	-	-	-	-
Planting	KES	648	-	-	-	-	-	-	-	-
Irrigation	KES	15,540	15,540	15,540	15,540	15,540	15,540	15,540	15,540	15,540
Weeding	KES	7,770	9,713	9,713	9,713	9,713	9,713	9,713	9,713	9,713
Pruning	KES	648	1,295	1,295	1,943	2,428	2,914	3,238	3,561	3,561
Spraying	-	-	324	486	648	648	648	648	648	648

Item	Unit	Year								
		1	2	3	4	5	6	7	8	9
Topdressing	KES	-	162	162	324	324	324	486	486	486
Pheromone traps 10@sh300 pa	-	-	-	1,214	1,214	1,214	1,214	1,214	1,214	1,214
Total Variable cost	KES	**58,884**	**34,274**	**37,208**	**42,078**	**44,215**	**51,137**	**57,531**	**58,098**	**61,068**
Gross Margin / Ha	KES	**(58,884)**	**(34,274)**	**48,652**	**109,439**	**222,835**	**318,566**	**431,113**	**518,237**	**656,115**

0	1	2	3	4	5	6	7	8	Totals
DISCost	**58,884**	**30,601**	**29,662**	**29,950**	**28,099**	**29,017**	**29,147**	**26,281**	**24,664**	**286,306**
DisBen	**0.00**	**0.00**	**48,315.56**	**80,885.43**	**129,994.44**	**162,493.05**	**189,989.75**	**202,446.69**	**223,363.28**	**1,037,488**
DF	1.0000	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066	0.4523	0.4039	**6.0**
NPV	-58884	-30601	18654	50935	101895	133476	160843	176166	198699	**751,182**
BCR	0	0	2	3	5	6	7	8	9	1
IRR										56%

Assumptions

- Plant Spacing 7.5m X 7.5m
- Price of NIS calculated at farmgate price of KES 150/kg
- Interest rate of 12%
- Production cycle of 9 years

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