



# INVENTORY OF CLIMATE SMART AGRICULTURE TECHNOLOGIES, INNOVATIONS AND MANAGEMENT PRACTICES FOR MACADAMIA VALUE CHAIN



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**INVENTORY OF CLIMATE SMART AGRICULTURE  
TECHNOLOGIES, INNOVATIONS AND MANAGEMENT PRACTICES  
FOR MACADAMIA VALUE CHAIN**

**National Agricultural and Rural Inclusive Growth Project  
(NARIGP)**

## **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 National Agricultural Rural and Inclusive Growth Project (NARIGP) tasked the Kenya Agricultural and Livestock Research Organization (KALRO) to develop and deliver context specific Climate Smart Agriculture (CSA) Technologies, Innovation and Management Practices (TIMPs). This document provides a detailed inventory of TIMPs that have been developed in macadamia value chain.

Extensive information from research and background data has been reviewed to help in development of this TIMPs inventory. To disseminate the TIMPs, a Training of Trainers (ToT) manual has been developed. The design of the manual takes into consideration the delivery system, partners and their roles, duration of training and logical flow of the modules. The training modules have uniform outline that ensures all aspects of the TIMPs are fully covered in a 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. This TIMPs inventory is therefore to be used in conjunction with the respective Macadamia ToT Manual. The uptake of these TIMPs is expected to contribute to increased productivity and profitability for improved incomes.

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

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

## **PREFACE**

The National Agricultural and Rural Inclusive Growth Project (NARIGP) is funded by the Government of Kenya and the World Bank. This Project is being implemented in 21 Counties in the country at an approximate cost of KES 22 billion and will run for five years. The Project development objective is *“To increase agricultural productivity and profitability of targeted rural communities in selected Counties, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response.”* To achieve the objective, the Project is promoting adoption of climate smart agricultural technologies, innovations and management practices (TIMPs) that maximize productivity, increase profitability and enhance commercialization.

The Project comprises of four (4) components: Component 1 involves strengthening community-level institutions’ ability to identify and implement investments that improve their agricultural productivity, food security, and nutritional status and linkages to selected value chains and Producer Organizations. Component 2 deals with strengthening and value chains development by building capacity to support members of targeted rural communities, which include Common Interest Groups (CIGs) and Vulnerable and Marginalized Groups (VMGs). Component 3 undertakes strengthening the capacity of County governments to support community-led development initiatives identified under Components 1 and 2. Component 4 is on project coordination, management, and monitoring and evaluation.

The Kenya Agricultural and Livestock Research Organization (KALRO) in conjunction with partners in the National Agricultural Research Systems (NARS) and Consultative Group for International Agricultural Research (CGIAR) compiled inventories of TIMPs as an initial step towards promotion of their adoption for the prioritized value chains. Of these, 13 are crop-based. They are roots and tubers (potatoes, sweetpotato); pulses (beans, green gram and cowpeas); vegetables (tomato, indigenous vegetables); cereals (sorghum), nuts (macadamia and coconut), fibres (cotton) and fruits (banana, avocado). The four (4) animal production-based value chains are apiculture, indigenous chicken (meat and eggs), dairy (cattle) and red meat (sheep and goats). In addition, there are three (3) cross cutting themes on pastures and fodder, natural resource management, and animal health.

The TIMPs were categorized into those ready for upscaling and those requiring validation. Gaps were identified for further research and development of TIMPs. This ToT manual focuses on TIMPs that are ready for upscaling of the Macadamia value chains and be used in training County extension staff, service providers, community based facilitators and lead farmers. Those trained are expected to cascade the training to beneficiaries in the targeted smallholder farming, agro-pastoral and pastoral communities in the 21 project Counties of Kirinyaga, Kiambu, Murang’a, Nakuru, Bungoma, Trans Nzoia, Nandi, Vihiga, Kisii, Nyamira, Migori, Homa Bay, Makueni, Meru, Kitui, Embu, Kilifi, Kwale, Narok, Samburu and Turkana.

The National Project Coordination Unit is grateful to all who participated in the development and production of this TIMPs inventory for the macadamia value chain. It is my hope that this inventory will be adopted and optimally used by the Counties.

**John Kimani**  
**National Project Coordinator**  
**National Agricultural Rural and Inclusive Growth Project**

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## LIST OF ABBREVIATIONS AND ACRONYMS

AAK	Agrochemical Association of Kenya
AFA	Agriculture & Food Authority
ASALs	Arid and Semi-Arid Lands
CA	Conservation Agriculture
CBO	Community Based Organization
CC	Climate Change
CCPs	Critical control points
CSA	Climate Smart Agriculture
FFBs	Farmer Field Business School
FGR	First Grade Ratio
FPEAK	Fresh Produce Exporters Association of Kenya
FSMS	Food Safety Management System
GAPs	Good Agricultural Practices
GHG	Green House Gases
ha	Hectare
HACCP	Hazard Analysis Critical Control Points
HCD	Horticultural Crop Directorate
IDM	Integrated Disease Management
IFPRI	International Food Policy Research Institute
IMM	Integrated Manure Management
INRM	Integrated Natural Resource Management
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility management
IWM	Integrated Weed Management
JICA	Japan International Cooperation Agency
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Project
KEPHIS	Kenya Plant Health Inspectorate Services
kg	Kilogram
KR	Kernel Recovery
NARIGP	National Agricultural and Rural Inclusive Growth Project
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organizations
NIS	Nuts in Shell
NUTPAK	Nut Processors Association of Kenya
PCPB	Pesticide Control Products Board
SWOT	Strengths, Weaknesses, Opportunities, Threats
TIMPs	Technologies, Innovations and Management Practices
ToTs	Training of Trainers
VMGs	Vulnerable and Marginalized Groups

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## 1.0 DEFINITION OF TERMS AND SUMMARY TABLES OF MACADAMIA 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 Macadamia Value Chain (VC)

The inventory process identified 83 TIMPs comprising 27 technologies, 8 innovations and 48 management practices, distributed among the 12 sub-themes, as indicated in the table below.

**Table 1 Summary of Macadamia TIMPs**

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Macadamia	Improved Macadamia varieties	4	0	0
Macadamia	Macadamia seed systems	5	0	1
Macadamia	GAPs and Food Safety	0	0	2
Macadamia	Agronomic management practices	0	0	8
Macadamia	Soil Fertility Management	2	1	3
Macadamia	Soil and Water Management	1	0	7
Macadamia	Macadamia Crop health	5	4	10
Macadamia	Postharvest management	1	0	4
Macadamia	Macadamia Value addition	6	0	0
Macadamia	Mechanization of Macadamia production activities	3	3	0

Macadamia	Macadamia business and Marketing	0	0	8
Macadamia	Agricultural Policy	0	0	5
<b>Total</b>		<b>27</b>	<b>8</b>	<b>48</b>

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

The inventory process resulted in a total of 73 TIMPs that are ready for up-scaling, 9 TIMPs that require validation and 1 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**

<b>Commodity/VC</b>	<b>Sub-Theme</b>	<b>Ready for up-scaling</b>	<b>Require validation</b>	<b>Further Research</b>
Macadamia	Improved Macadamia varieties	4	0	0
Macadamia	Macadamia seed system	6	0	0
Macadamia	GAPs and Food Safety	2	0	0
Macadamia	Agronomic management practices	8	0	0
Macadamia	Soil Fertility Management	2	3	0
Macadamia	Soil and Water Management	10	0	0
Macadamia	Macadamia Crop health	15	2	1
Macadamia	Postharvest management	5	0	0
Macadamia	Macadamia Value addition	6	0	0
Macadamia	Mechanization of Macadamia production activities	2	4	0
Macadamia	Macadamia business and Marketing	8	0	0
Macadamia	Agricultural Policy	5	0	0
<b>Overall Total</b>		<b>73</b>	<b>9</b>	<b>1</b>

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

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
<b>2.1 Improved Macadamia varieties</b>	2.1.1 MRG – 20	Technology	Ready for Upscaling
	2.1.2 KRG – 15	Technology	Ready for Upscaling
	2.1.3 EMB – 1	Technology	Ready for Upscaling
	2.1.4 KMB – 3	Technology	Ready for Upscaling
<b>2.2 Macadamia seed system</b>	2.2.1 Enhancing Macadamia seed germination by use of sand beds	Management practice	Ready for upscaling
	2.2.2 Top Wedge Grafting	Technology	Ready for upscaling
	2.2.3 Veneer Grafting Method	Technology	Ready for upscaling
	2.2.4 Splice Grafting Method	Technology	Ready for upscaling
	2.2.5 Bark Grafting/Top Working	Technology	Ready for upscaling
	2.2.6 Macadamia Approach grafting method	Technology	Ready for upscaling
<b>2.3 Good Agricultural Practices and Food Safety Management Systems</b>	2.3.1 Good Agricultural Practices	Management practice	Ready for upscaling
	2.3.2 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Macadamia in Kenya	Management Practice	Ready for Upscaling
<b>2.4 Agronomic management practices</b>	2.4.1 Site Selection	Management Practice	Ready for upscaling
	2.4.2 Land Preparation	Management Practice	Ready for upscaling
	2.4.3 Spacing & orchard establishment	Management Practice	Ready for upscaling
	2.4.4 Staking	Management Practice	Ready for up-scaling
	2.4.5 Erection of wind breaks	Management practice	Ready for up-scaling
	2.4.6 Intercropping	Management practice	Ready for up-scaling
	2.4.7 Pruning	Management practice	Ready for upscaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
	2.4. 8 Macadamia manure/fertilizer application	Management practice	Ready for up-scaling
<b>2.5 Soil fertility management</b>	2.5.1 Integrated Manure Management	Management practice	Requires validation
	2.5.2 Integrated Soil Fertility Management	Complimentary Technology	Requires validation
	2.5.3 Rapid Soil Testing Services	Innovation	Requires validation
<b>2.6 Soil and water management</b>	2.6.1 Contour bands	Management practice	Ready for upscaling
	2.6.2 Contour drainage ditches	Management practice	Ready for upscaling
	2.6.3 Bench terraces	Management practice	Ready for upscaling
	2.6.4 Fanya Juu terraces	Management practice	Ready for upscaling
	2.6.5 Retention Ditches	Management practice	Ready for upscaling
	2.6.6 Grass strips	Management practice	Ready for upscaling
	2.6.7 Rain water harvesting	Management practice	Ready for upscaling
	2.6.8 Conservation Agriculture	Management practice	Ready for upscaling
	2.6.9 Agroforestry	Management practice	Ready for upscaling
	2.6.10 Drip Irrigation	Technology	Ready for upscaling
<b>2.7 Macadamia Crop Health</b>	2.7.1 Integrated management of Macadamia stinkbug	Management Practice	Requires validation
	2.7.2 Integrated management of Nutborers	Management Practice	Ready for upscaling
	2.7.3 Integrated management of Giant Rat	Management Practice	Requires validation
	2.7.4 Integrated management of Thrips	Management Practice	Requires further research
	2.7.5 Integrated management of Phytophthora Trunk Canker and Root Rot Diseases	Management Practice	Ready for upscaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
	2.7.6 Integrated management of Husk Spot Disease	Management Practice	Ready for upscaling
	2.7.8 Integrated management of Botrytis Blight (Raceme) Disease	Management Practice	Ready for upscaling
<b>Weed Management</b>	2.7.9 Intergrated Weed Management	Innovation	Ready for upscaling
	2.7.10 Macadamia Intercropping	Innovation	Ready for upscaling
	2.7.11 Cover cropping for Macadamia weed managemnt	Technology	Ready for upscaling
	2.7.12 Mulching for Weed control	Technology	Ready for upscaling
	2.7.13 Herbicide (Chemical ) weed control	Technology	Ready for upscaling
	2.7.14 Solalization of beds for weed control	Technology	Ready for upscaling
	2.7.15 Stale seed bed for weed control	Technology	Ready for Upscaling
	2.7.16 Mechanical weeding	Innovation	Ready for Upscaling
	2.7.17 Crop Rotation of intercrops in macadamia	Management Practice	Ready for Upscaling
	2.7.18 Safe use of Pesticides	Management Practice	Ready for Upscaling
<b>2.8 Harvest and Postharvest management</b>	2.8.1 Macadamia harvesting	Management practice	Ready for upscaling
	2.8.2 Dehusking of Macadamia nuts	Management practice	Ready for upscaling
	2.8.3 Drying of Macadamia NIS	Management practice	Ready for upscaling
	2.8.4 Grading of NIS	Technology	Ready for upscaling
	2.8.5 Storage of NIS	Management practice	Ready for upscaling

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
<b>2.9 Macadamia Value Addition</b>	2.9.1 Cracking on NIS	Technology	Ready for upscaling
	2.9.2 Roasting of Macadamia Kernels	Technology	Ready for upscaling
	2.9.3 Salting roasted macadamia kernels	Technology	Ready for upscaling
	2.9.4 Honey coated macadamia Kernels	Technology	Ready for upscaling
	2.9.5 Chocolate coated macadamia kernels	Technology	Ready for upscaling
	2.9.6 Packaging of processed macadamia kernels	Technology	Ready for upscaling
<b>2.10 Mechanization of Macadamia production activities</b>	2.10.1 Grafting Machine	Innovation	Require validation`
	2.10.2 Mould board plough	Technology	Ready for upscaling
	2.10.3 Harrow	Technology	Ready for upscaling
	2.10.4 Seedling trans planter	innovation	Require validation
	2.10.5 Motorized knapsack	Technology	Requires validation
	2.10.6 Harvester	Innovation	Require validation
<b>2.11 Macadamia Value Chain Business and marketing</b>	1. Business models and inclusive market development in Macadamia value chain	Management Practices	Ready for upscaling
	2. Developing a Business Plan for macadamia farm Business		Ready for upscaling
	3. Implementing of Record keeping and Macadamia enterprise analysis	Management Practices	Ready for upscaling
	4. Profitability analysis macadamia agro- enterprise	Management Practices	Ready for upscaling
	5. Scaling up and scaling out plan of macadamia agro-enterprise	Management Practices	Ready for upscaling
	6. Marketing as a group/Collective marketing (producer organization) as a marketing strategy	Management Practices	Ready for upscaling
	7. Participatory market research for macadamia products	Management Practices	Ready for upscaling
	8. Contract farming as a marketing	Management	Ready for

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
	strategy	Practices	upscaling
	9. E-marketing of macadamia products: Internet/online/mobile marketing	Management Practices	Ready for upscaling
<b>2.12. Agricultural Policy options influencing Macadamia enterprise</b>	1. Regional and National Agricultural policy framework and strategies supporting Macadamia agro-enterprise	Management Practices	Ready for upscaling
	2. Policy options influencing Macadamia producers and other value chain actors	Management Practices	Ready for upscaling
	3. Policy Instruments influencing Macadamia value chain Actors	Management Practices	Ready for upscaling
	4. Policy cycle and implementation at county level of macadamia value chain	Management Practices	Ready for upscaling
	5. Policy validation customization for macadamia value chain	Management Practices	Ready for upscaling

## 2.0 DETAILED MACADAMIA VALUE CHAIN TIMPS

### Macadamia Suitability Map

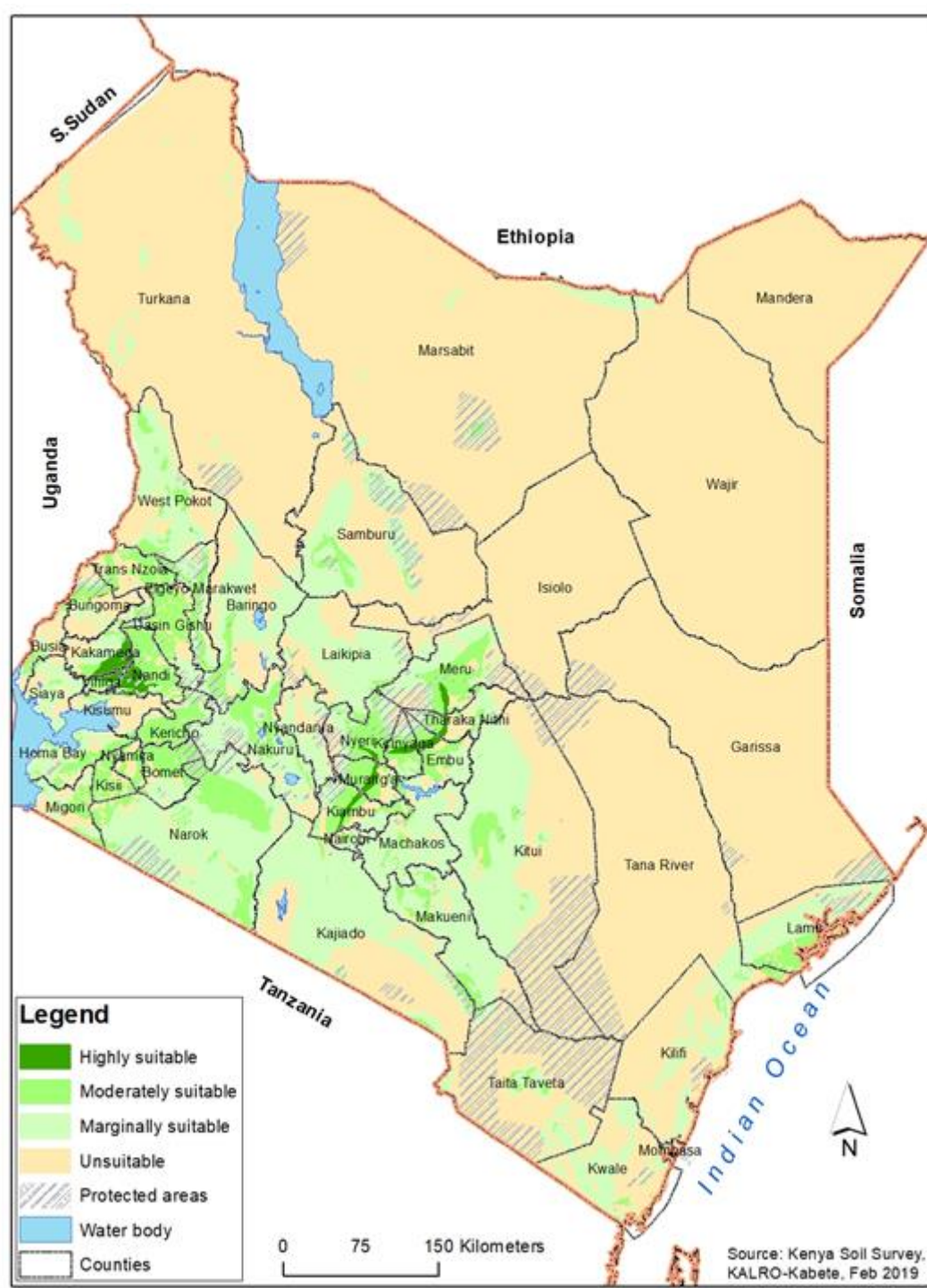



Fig. 1. Macadamia nut production suitability map (Source: Kenya Soil Survey)

## 2.1 Macadamia Varieties

<b>2.1.1 TIMP Name</b>	<b>Macadamia variety: MRG-20</b>
Category (i.e. technology, innovation or management practice)	Technology  <i>Nut cluster of MRG – 20 Variety</i>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields in Macadamia Nuts at altitudes of between 1200 and 1500 m asl
What is it? (TIMP description)	This Macadamia variety suitable for the marginal coffee to the main coffee zones of altitudes between 1200 – 1500 metres above sea level. It is a high yielder (55kg/tree/year) with large clusters (average size 13nuts per cluster). In the target zone it bears through out the year with a First Grade Ratio (FGR) of 91% with average Kernel Recovery percentages(KR%) of 33%
Justification	Planting of the non suitable Macadamia varieties for many regions is rampant. Yield of Macadamia varieties is dependedent on suitability of the target zones and the genetic potential of the variety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Processors, Nursery operators, Traders, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Macadamia Innovation Platforms</li> <li>• Macadamia Farmer Field and Business Schools</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• MoA/Public and Private extension providers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> </ul>

	<ul style="list-style-type: none"> <li>• Web material's</li> <li>• Mobile</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive research to test and validate variety suitability in non macadamia traditional areas</li> <li>• Research Extension Liason fora</li> <li>• Positive interaction between Farmers &amp; Processors</li> <li>• Mechanism for interaction of Macadamia value chain stakeholders</li> <li>• Clean planting material availability</li> <li>• Good Marketing Models and path ways</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote new Macadamia varieties</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) and International research organizations</li> <li>• Market/processors players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs for farmer organizing and mobilization e.g. SACDEP</li> <li>• Registered nurseries for clean seedling production</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Nyeri, Embu, Meru, Muranga, Kirinyaga, Tharaka Nithi, Kisii, Kericho, Nandi, Bungoma and Transoia
Counties where TIMP will be up scaled	All suitable areas including new areas of cultivation such as Kakamega, Vihiga, Kisumu, Migori, Kajiado, Narok, Machakos, Makueni & Taita Taveta
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of a mechanism to facilitate interaction of VC stakeholders</li> <li>• Inadequate/Poor distribution of planting materials</li> <li>• Wide scope of possible production areas</li> <li>• Low use of agronomic practices</li> <li>• Unorganized marketing channels</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Involve County governments, extension and Nursery operators</li> <li>• Engagement of wider range of stakeholders</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote value addition and consumption in local food systems</li> <li>• Promote marketing models that encourage collective</li> </ul>



	production and marketing
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful upscaling are higher when diverse value chain players collaborate in an innovation platform</li> <li>• Training of agro dealers necessary</li> <li>• Farmers participatory approach works</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on the nutritional benefits of the variety.</li> <li>• Harmonious and collaborative interaction of diverse value chain players in Macadamia innovation platforms</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability.</li> <li>• Organized marketing channels critical for benefits to be derived from the technology</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre. This is the cost of purchasing seed, which is 51% of the cost of establishing and bringing the crop to yielding.
Estimated returns	Gross KES 585,570 per acre. Net returns (= KES 585,570 - 57,216 being variety cost + all other accompanying technology costs)= <b>KES 528,534.00 per acre</b>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Since Macadamia is a cash crop, it is regarded as a man’s enterprise, Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings than men</li> <li>• The technology may not be adopted if the gender targeted (especially women) is overburdened with other responsibilities</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic. This disadvantages them on awareness of such new varieties</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for men exist in commercializing Macadamia technology</li> <li>• Opportunities for men exist in macadamia production and marketing</li> <li>• Opportunities for youths exist in transportation of the produce to the market</li> <li>• Women and children mainly involved in the harvesting and dehusking procedures</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit and quality seedlings than men</li> <li>• Due to their social status VMGs are often excluded from decision making in the development and dissemination activities</li> <li>• VMGs have less access to agricultural information,</li> </ul>

	<p>technology and knowledge than men</p> <ul style="list-style-type: none"> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exist in commercializing the technology</li> <li>• Opportunities exists for VMG particularly in the harvesting processes since harvesting is done from the ground</li> <li>• Opportunities for youths exists in transportation of the produce to the market</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Development of the current varieties from previously JICA funded project
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	<p>Officer in Charge, KALRO Practical Training Centre  E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>  The Institute Director, KALRO-HRI Thika;  E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>  The Centre director, KALRO-Kabete;  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>  The Institute director, KALRO-FCRI Kitale;  E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>
Lead organization and scientists	Antony N., Watani G., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO PTC, KALRO Kandara, MoALF, Agricultural University Colleges, IFPRI.

### Research Gaps

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


<b>2.1.2 TIMP Name</b>	<b>Macadamia variety: EMB -1</b>
Category (i.e. technology, innovation or management practice)	<b>Technology</b>

	  <p style="text-align: center;"><b><i>Characteristic tree shape and Nut clusters of EMB – 1 Variety. Note the curly leaves</i></b></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields in Macadamia Nuts and low Kernel Recovery Percentage (KR %)
What is it? (TIMP description)	<p>This variety is suitable for the main coffee zones of altitudes between 1550—1650 metres above sea level with precipitation above 1200 mm pa. It has white flowers, curly leaves with few spines. The Nuts are perfectly smooth and round. Trees are cone shaped.</p> <p>The variety yields 70kg (at 15 years) and bears all year round with a high KR% of 35% and FGR of 93%. The Variety tends to have small cluster sizes (5) but has high cluster number counts (17). The shell thickness of this variety is always below 3mm.</p>
Justification	Planting of the non suitable Macadamia varieties for many regions is rampant. Yield of Macadamia varieties is dependedent on suitability of the target zones and the genetic potential of the variety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Processors, Nursery operators, Traders, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Macadamia Innovation Platforms</li> <li>• Macadamia Farmer Field and Business Schools</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> </ul>

	<ul style="list-style-type: none"> <li>• Field days</li> <li>• Agricultural shows</li> <li>• MoA/Public and Private extension providers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Mobile</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive research to test and validate variety suitability in non macadamia traditional areas</li> <li>• Research Extension Liason fora</li> <li>• Positive interaction between Farmers &amp; Processors</li> <li>• Mechanism for interaction of Macadamia value chain stakeholders</li> <li>• Clean planting material availability</li> <li>• Good Marketing Models and path ways</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote new Macadamia varieties</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) and International research organizations</li> <li>• Market/processors players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs for farmer organizing and mobilization e.g. SACDEP</li> <li>• Registered nurseries for clean seedling production</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Nyeri, Embu, Meru, Muranga, Kirinyaga, Tharaka Nithi, Kisii, Kericho, Nandi, Bungoma and Transoia
Counties where TIMP will be up scaled	All suitable areas including new areas of cultivation such as Kakamega, Vihiga, Kisumu, Migori, Kajiado, Narok, Machakos, Makueni & Taita Taveta
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of a mechanism to facilitate interaction of VC stakeholders</li> <li>• Inadequate/Poor distribution of planting materials</li> <li>• Wide scope of possible production areas</li> <li>• Low use of agronomic practices</li> <li>• Unorganized marketing channels</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Involve County governments, extension and Nursery operators</li> <li>• Engagement of wider range of stakeholders</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote value addition and consumption in local food systems</li> <li>• Promote marketing models that encourage collective production and marketing</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful upscaling are higher when diverse value chain players collaborate in an innovation platform</li> <li>• Training of agro dealers necessary</li> <li>• Farmers participatory approach works</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on the nutritional benefits of the variety.</li> <li>• Harmonious and collaborative interaction of diverse value chain players in Macadamia innovation platforms</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability.</li> <li>• Organized marketing channels critical for benefits to be derived from the technology</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre. This is the cost of purchasing seed, which is 51% of the cost of establishing and bringing the crop to yielding. The total cost for all technologies is KES 57,216 per acre
Estimated returns	Gross incomes of KES 745,500.00 per acre. Net Returns (=KES 745,500 -57,216) = <b>KES 688,284.00 per acre</b>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Since Macadamia is a cash crop, it is regarded as a man’s enterprise, Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings than men</li> <li>• The technology may not be adopted if the gender targeted (especially women) is overburdened with other responsibilities</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic. This disadvantages them on awareness of such new varieties</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for men exist in commercializing Macadamia technology</li> <li>• Opportunities for men exist in macadamia production and marketing</li> </ul>


	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in transportation of the produce to the market</li> <li>• Women and children mainly involved in the harvesting and dehusking procedures</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit and quality seedlings than men</li> <li>• Due to their social status VMGs are often excluded from decision making in the development and dissemination activities</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exist in commercializing the technology</li> <li>• Opportunities exists for VMG particularly in the harvesting processes since harvesting is done from the ground</li> <li>• Opportunities for youths exists in transportation of the produce to the market</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	All large scale farms in Kenya currently using only the improved varieties developed by KALRO (Then KARI) and promoted the the then Kenya-Japan HDP Horticultural Development Project(1990 -2005)
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>
Lead organization and scientists	Antony N., Watani G., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO PTC, KALRO Kandara, MoALF, Agricultural University Colleges, IFPRI.




<b>2.1.3 TIMP Name</b>	<b>Macadamia variety: KRG – 15</b>
Category (i.e. technology, innovation or management practice)	Technology  <p style="text-align: center;"><i>Characteristics of KRG – 15 Variety Nut Cluster</i></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields in Macadamia Nuts and low Kernel Recovery Percentage (KR %)
What is it? (TIMP description)	This variety is suitable for the main coffee zones of altitudes between 1550—1650 Metres above sea level with precipitation above 1200 mm pa. The tree has white flowers with open tree formation. Leaves are moderately spinny with an apex. It is a variety that yields high (80kg at 15 years) and bears all year round with a high KR% of 39% and a FGR of 91%. The shell thickness of this variety is always below 3mm.
Justification	Yield of Macadamia varieties is dependedent on suitability of the target zones and the genetic potential of the variety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Processors, Traders, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Macadamia Innovation Platforms</li> <li>• Macadamia Farmer Field and Business Schools</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• MoA/County Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Mobile</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive research to release and validate any new Macadamia varieties</li> <li>• Positive interaction between Farmers &amp; Processors</li> <li>• Mechanism for interaction of Macadamia value chain stakeholders</li> <li>• Clean planting material availability</li> <li>• Good seed system (Nurseries) to ensure quality</li> <li>• Well organized farmer groups and networks</li> <li>• Good Marketing Models and path ways</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote new Macadamia varieties</li> <li>• Collaboration between all partners and stakeholders</li> <li>• Adequate facilitation</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) and International research organizations</li> <li>• Market/processors players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs for farmer organizing and mobilization e.g. SACDEP</li> <li>• Registered nurseries for clean seedling production</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Nyeri, Embu, Meru, Muranga, Kirinyaga, Tharaka Nithi, Kisii, Kericho, Nandi, Bungoma and Transoia
Counties where TIMP will be up scaled	All suitable areas including new areas of cultivation such as Kakamega, Vihiga, Kisumu, Migori, Kajiado, Narok, Machakos, Makeni & Taita Taveta
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of a mechanism to facilitate interaction of VC stakeholders</li> <li>• Inadequate/Poor distribution of planting materials</li> <li>• Wide scope of possible production areas</li> <li>• Low use of agronomic practices</li> <li>• Unorganized marketing channels</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Involve County governments, extension and Nursery operators</li> <li>• Engagement of wider range of stakeholders</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote value addition and consumption in local food systems</li> </ul>

	<ul style="list-style-type: none"> <li>Promote marketing models that encourage collective production and marketing</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>Chances of successful upscaling are higher when diverse value chain players collaborate in an innovation platform</li> <li>Training of agro dealers necessary</li> <li>Farmers participatory approach works</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>Creation of awareness on the nutritional benefits of the variety.</li> <li>Harmonious and collaborative interaction of diverse value chain players in Macadamia innovation platforms</li> <li>It is an already “a climate change ready crop” due to its wide adaptation ability.</li> <li>Organized marketing channels critical for benefits to be derived from the technology</li> <li>Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre. This is the cost of purchasing seed, which is 51% of the cost of establishing and bringing the crop to yielding. The total cost for all technologies is KES 57,216 per acre
Estimated returns	Gross incomes of KES 852,000 per acre. Net Returns (=KES 852,000 -57,216) = <b>KES 794,784.00 per acre</b>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Since Macadamia is a cash crop, it is regarded as a man’s enterprise, Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings than men</li> <li>The technology may not be adopted if the gender targeted (especially women) is overburdened with other responsibilities</li> <li>Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic. This disadvantages them on awareness of such new varieties</li> <li>Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Opportunities for men exist in commercializing Macadamia technology</li> <li>Opportunities for men exist in macadamia production and marketing</li> <li>Opportunities for youths exist in transportation of the produce to the market</li> <li>Women and children mainly involved in the harvesting and dehusking procedures</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have limited access to productive resources such as land, credit and quality seedlings than men</li> <li>Due to their social status VMGs are often excluded from decision making in the development and dissemination activities</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exist in commercializing the technology</li> <li>• Opportunities exists for VMG particularly in the harvesting processes since harvesting is done from the ground</li> <li>• Opportunities for youths exists in transportation of the produce to the market</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	All large scale farms in Kenya currently using only the improved varieties developed by KALRO (Then KARI) and promoted the the then Kenya-Japan HDP Horticultural Development Project(1990 -2005)
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2- requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>
Lead organization and scientists	Antony N., Watani G., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO PTC, KALRO Kandara, MoALF, Agricultural University Colleges, IFPRI.

<b>2.1.4 TIMP Name</b>	<b>Macadamia variety: KMB - 3</b>
Category (i.e. technology, innovation or management practice)	<b>Technology</b> 



	   <p style="text-align: center;"><b>Characteristics of KMB - 3 Variety pink flowers, long spiny leaves, pink tips and cream large kernels (Respectively)</b></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low yields in Macadamia Nuts and low Kernel Recovery Percentage (KR %)
What is it? (TIMP description)	<p>A Hybrid variety suitable for the coffee-tea zones of altitudes between 1650– 1900 Metres above sea level, with precipitation above 1500 mm pa. It has distinct pink shoots and flowers and long leaves with many spines and a pronounced apex.</p> <p>It is a high yielding variety (60kg at 15 years pa) and has a distinct peak harvesting season of May – August. It has a KR% of 35% and FGR of 90%. The variety has small cluster sizes (5 nuts per cluster) with large a large cluster count of 13. The shell thickness of this variety is always below 3mm.</p>
Justification	Yield of Macadamia varieties is dependedent on suitability of the target zones and the genetic potential of the variety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Processors, Traders, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Macadamia Innovation Platforms</li> <li>• Macadamia Farmer Field and Business Schools</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• MoA/County Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Mobile</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive research to release and validate any new Macadamia varieties</li> <li>• Positive interaction between Farmers &amp; Processors</li> <li>• Mechanism for interaction of Macadamia value chain stakeholders</li> <li>• Clean planting material availability</li> <li>• Good seed system (Nurseries) to ensure quality</li> <li>• Well organized farmer groups and networks</li> <li>• Good Marketing Models and path ways</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote new Macadamia varieties</li> <li>• Collaboration between all partners and stakeholders</li> <li>• Adequate facilitation</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) and International research organizations</li> <li>• Market/processors players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs for farmer organizing and mobilization e.g. SACDEP</li> <li>• Registered nurseries for clean seedling production</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Nyeri, Embu, Meru, Muranga, Kirinyaga, Tharaka Nithi, Kisii, Kericho, Nandi, Bungoma and Transoia
Counties where TIMP will be up scaled	All suitable areas including new areas of cultivation such as Kakamega, Vihiga, Kisumu, Migori, Kajiado, Narok, Machakos, Makueni & Taita Taveta
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of a mechanism to facilitate interaction of VC stakeholders</li> <li>• Inadequate/Poor distribution of planting materials</li> <li>• Wide scope of possible production areas</li> <li>• Low use of agronomic practices</li> <li>• Unorganized marketing channels</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Involve County governments, extension and Nursery operators</li> <li>• Engagement of wider range of stakeholders</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote value addition and consumption in local food systems</li> <li>• Promote marketing models that encourage collective</li> </ul>

	production and marketing
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful upscaling are higher when diverse value chain players collaborate in an innovation platform</li> <li>• Training of agro dealers necessary</li> <li>• Farmers participatory approach works</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on the nutritional benefits of the variety.</li> <li>• Harmonious and collaborative interaction of diverse value chain players in Macadamia innovation platforms</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability.</li> <li>• Organized marketing channels critical for benefits to be derived from the technology</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre. This is the cost of purchasing seed, which is 51% of the cost of establishing and bringing the crop to yielding. The total cost for all technologies is KES 57,216 per acre
Estimated returns	Gross incomes of KES 639,000.00 per acre. Net Returns (=KES 639,000.00 -57,216) = <b>KES 581,784.00 per acre</b>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Since Macadamia is a cash crop, it is regarded as a man’s enterprise, Women and youth may have less access to productive resources such as credit, labour, land and quality seedlings than men</li> <li>• The technology may not be adopted if the gender targeted (especially women) is overburdened with other responsibilities</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic. This disadvantages them on awareness of such new varieties</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for men exist in commercializing Macadamia technology</li> <li>• Opportunities for men exist in macadamia production and marketing</li> <li>• Opportunities for youths exist in transportation of the produce to the market</li> <li>• Women and children mainly involved in the harvesting and dehusking procedures</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit and quality seedlings than men</li> <li>• Due to their social status VMGs are often excluded from decision making in the development and dissemination activities</li> <li>• VMGs have less access to agricultural information,</li> </ul>

	<p>technology and knowledge than men</p> <ul style="list-style-type: none"> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exist in commercializing the technology</li> <li>• Opportunities exists for VMG particularly in the harvesting processes since harvesting is done form the ground</li> <li>• Opportunities for youths exists in transportation of the produce to the market</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	All large scale farms in Kenya currently using only the improved varieties developed by KALRO (Then KARI) and promoted the the then Kenya-Japan HDP Horticultural Development Project(1990 -2005)
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	<p>Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>
Lead organization and scientists	Antony N., Watani G., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO PTC, KALRO Kandara, MoALF, Agricultural University Colleges, IFPRI.

## 2.2 Macadamia Seed Systems

2.2.1 TIMP Name	Enhancing Macadamia seed germination by use of sand beds
Category (i.e. technology, innovation or management practice)	<p>Management practice</p> <div style="display: flex; justify-content: space-around;">   </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px; text-align: center;"><i>Seeding soaked nuts in sandbed</i></div> <div style="border: 1px solid black; padding: 2px; text-align: center;"><i>Germinated rootstocks</i></div> </div>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low germination of macadamia seed nuts when seeded directly in normal soil media
What is it? (TIMP description)	Freshly harvested seed nuts from recommended varieties such as KMB-3 or EMB-1 are used as give the best germination percentage of 50 – 60. Sort out from seed lot for insect or disease damaged nuts. Subject the nuts to floatation in cold water. Fresh and viable seed will sink while the immature or damaged floats. The sunk seed nuts are soaked in cold water for 72 hours before sowing in river sand beds. Germination takes approximately three weeks after seeding which continues even up to the third month from the time of sowing.
Justification	Germination of macadamia is dependant on varieties used and the method applied.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Nursery owners, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• MoA/Extension service providers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> </ul>
Critical/essential factors for	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and</li> </ul>

successful promotion	<ul style="list-style-type: none"> <li>release the developed management practices</li> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Development of good seed systems to backstop community and rural nurseries</li> <li>• Seedling availability and accessibility through macadamia research to develop new varieties</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote seedling production</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) for capacity building</li> <li>• Nursery owners for quality macadamia seed multiplication</li> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs to take up macadamia seedlings production e.g. MESPT, for farmer organization and mobilization</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low use of suitable seed nuts for macadamia rootstock development</li> <li>• Lack of knowhow by nursery operators</li> <li>• Unwillingness of farmers/nursery operators to procure quality seed nuts</li> <li>• Limited number of nurseries willing to propagate macadamia</li> <li>• Low graft takes in macadamia</li> <li>• Low use of good agronomic practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Train farmers/nursery operators on seed selection, use of correct media and empower their ability to access good seed nuts</li> <li>• Research to develop high yielding superior varieties with quality seed nuts</li> <li>• Information dissemination on importance of using good seed nuts to increase yield</li> </ul>


	<ul style="list-style-type: none"> <li>• Involve County governments, extension, and seed companies</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations</li> <li>• Availability of market is key</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on use of macadamia nuts on nutritional importance of the crop in consideration to the social cultural set up of the target communities.</li> <li>• Harmonious gender and social consideration in research, consumption and marketing.</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability. .</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 285 per seedling=285,000/1,000seedling
Estimated returns	KES 400,000 per 1,000 seedlings. Returns =KES 115,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have limited access to education, training and extension services than men</li> <li>• Macadamia crop is considered a man enterprise thereby limiting women control and benefit from them</li> <li>• Women have less access to agricultural information, technology and knowledge on macadamia production than men</li> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women have less access to farm implements than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth as nursery operators, service providers and marketing of the produce</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth and those recovering from drugs as nursery operators, service providers and marketing of the produce</li> <li>• Macadamia is nutritious and well adopted in the country hence will act as a food security crop for the VMGs</li> <li>• The technology is acceptable and easy to upscale by all the various gender categories including the</li> </ul>

	VMGs
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Nurseries</li> <li>• Private Nurseries</li> <li>• Increased uptake of KALRO macadamia grafted seedlings</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O BOX 220- 01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

### Research Gaps

3. Methods of further enhancing germination percentages and uniformity in macadamia
4. Methods of shortening the propagation cycle


<b>2.2.2 TIMP Name</b>	<b>Top Wedge Grafting Method</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Low graft takes in macadamia propagation
What is it? (TIMP description)	Top Wedge grafting method is used where the stock and the

	<p>scion are of similar diameters. The diameter should be 4 – 6 mm or pencil size thickness A wedge – like slanting cut is made at the base of the scion with a sharp grafting knife. The two pieces are fitted together, wrapped firmly with a grafting tape and then sealed with grafting wax. The grafted seedlings should be tendered in tunnels or individual polybags</p>  <p style="text-align: center;"><i>a</i>                      <i>b</i>                      <i>c</i>                      <i>d</i></p> <p><i>a – Ready rootstocks to graft</i>  <i>b – Ready prepared scion for placement to rootstock</i>  <i>c – Taping of Scion already inserted in rootsock</i>  <i>d – Tunnels for placing freshly grafted rootstocks</i></p> <p>The success takes rate of this method is 80-100% if done correctly</p>
Justification	<p>Grafting of macadamia nuts has faced numerous challenges with the major one being low graft takes. This is mainly associated with the hard woodiness of the crop and poor grafting skills. Failures of up to 100% have been reported. Correct use of top wedge grafting method leads to high graft takes and high quality seedlings. In addition grafted seedlings take shorter periods to bearing (3-4) years as compared to un grafted materials that take over 12 yers</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Nursery owners, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material’s</li> </ul>
Critical/essential factors for	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and</li> </ul>

successful promotion	<p>release the developed management practices</p> <ul style="list-style-type: none"> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Development of good seed systems to backstop community and rural nurseries</li> <li>• Seedling availability and accessibility through macadamia research to develop new varieties</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote seedling production</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) for capacity building</li> <li>• Nursery owners for quality macadamia seed multiplication</li> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs to take up macadamia seedlings production e.g. MESPT, for farmer organization and mobilization</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low use of suitable seed nuts for macadamia rootstock development</li> <li>• Lack of knowhow by nursery operators</li> <li>• Unwillingness of farmers/nursery operators to procure quality seed nuts</li> <li>• Limited number of nurseries willing to propagate macadamia</li> <li>• Low graft takes in macadamia</li> <li>• Low use of good agronomic practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Train farmers/nursery operators on seed selection, use of correct media and empower their ability to access good seed nuts</li> <li>• Research to develop high yielding superior varieties with quality seed nuts</li> <li>• Information dissemination on importance of using good seed nuts to increase yield</li> <li>• Involve County governments, extension, and seed companies</li> </ul>

Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations</li> <li>• Availability of market is key</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on use of macadamia nuts on nutritional importance of the crop in consideration to the social cultural set up of the target communities.</li> <li>• Harmonious gender and social consideration in research, consumption and marketing.</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability. .</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 285 per seedling=285,000/1,000seedling
Estimated returns	KES 400,000 per 1,000 seedlings. Returns =KES 115,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The running of nurseries and handling of specialized tools seems to more of the Men and youth dominated comared to women</li> <li>• All genders have equal opportunities except that nurseries being capital intensive, Women and youth may not access resources for this, particulary if the source is within the household</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth as tree servicer providers in tree grafting as well as transporting the produce to the market</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the VMG as skilled service providers as the operations are not labour intensive</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Nurseries</li> <li>• Private Nurseries</li> <li>• Increased uptake of KALRO macadamia grafted seedlings</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>



<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O BOX 220- 01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcri@kalro.org">director.fcri@kalro.org</a>

<b>2.2.3 TIMP Name</b>	<b>Side Wedge Grafting Method</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Grafting of overgrown rootstocks
What is it? (TIMP description)	<p>This method is used in overgrown rootstocks with a larger diameter than the scion. The scion is inserted into the side of the stock. A 3cm deep cut is made on the stock at an angle of 20 – 30 and the tapered scion with 2 sets of buds inserted.</p>  <p style="text-align: center;"><i><b>a</b></i>                      <i><b>b</b></i>                      <i><b>c</b></i></p> <p><i><b>a – Inserting a prepared scion on sede cut already made on the overgrown rootstock</b></i></p> <p><i><b>b – Already stabilized rootstock / scion union after insertion</b></i></p> <p><i><b>c – Taping of the graft union ready for waxing</b></i></p> <p>The grafted seedlings are then tendered under partial shade without covering them with poly-bags or poly sheets as in the case</p>

	of top-wedge
Justification	Sometimes rootstocks get overgrown in the nursery due to various reasons such as in availability of scions, inappropriate weather for grafting or water shortages in the nursery. Once overgrown, the top wedge method is inappropriate. Side wedge grafting is used in such cases with high success rates.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Nursery owners, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release the developed management practices</li> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Development of good seed systems to backstop community and rural nurseries</li> <li>• Seedling availability and accessibility through macadamia research to develop new varieties</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote seedling production</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) for capacity building</li> <li>• Nursery owners for quality macadamia seed multiplication</li> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs to take up macadamia seedlings production e.g. MESPT, for farmer organization and mobilization</li> <li>• Financial institutions e.g. Banks, donors and other</li> </ul>

	credit facilitators for financial solutions
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low use of suitable seed nuts for macadamia rootstock development</li> <li>• Lack of knowhow by nursery operators</li> <li>• Unwillingness of farmers/nursery operators to procure quality seed nuts</li> <li>• Limited number of nurseries willing to propagate macadamia</li> <li>• Low graft takes in macadamia</li> <li>• Low use of good agronomic practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Train farmers/nursery operators on seed selection, use of correct media and empower their ability to access good seed nuts</li> <li>• Research to develop high yielding superior varieties with quality seed nuts</li> <li>• Information dissemination on importance of using good seed nuts to increase yield</li> <li>• Involve County governments, extension, and seed companies</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations</li> <li>• Availability of market is key</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on use of macadamia nuts on nutritional importance of the crop in consideration to the social cultural set up of the target communities.</li> <li>• Harmonious gender and social consideration in research, consumption and marketing.</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability. .</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 285 per seedling=285,000/1,000seedling
Estimated returns	KES 400,000 per 1,000 seedlings. Returns =KES 115,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The running of nurseries and handling of specialized tools seems to more of the Men and youth dominated comared to women</li> <li>• All genders have equal opportunities except that nurseries being capital intensive, Women and youth may not access resources for this, particulary if the source is within the household</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth as tree</li> </ul>



	servicer providers in tree grafting as well as transporting the produce to the market
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the VMG as skilled service providers as the operations are not labour intensive</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Nurseries</li> <li>• Private Nurseries</li> <li>• Increased uptake of KALRO macadamia grafted seedlings</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O BOX 220- 01000, Thika
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Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

<b>2.2.4 TIMP Name</b>	<b>Splice Grafting Method</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Grafting of overgrown rootstocks that have exceeded the veneer grafting stage
What is it? (TIMP description)	<p>The method is usually used for overgrown rootstocks. A simple slanting cut of the same length and angle is made on both the stock and the scion. They are placed together and wrapped with the grafting tape and sealed with wax. Sealing is done on the entire scion wood and the graft union. Tendering of grafted-seedlings is same as that of the side wedge</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><i>a</i></p> </div> <div style="text-align: center;">  <p><i>b</i></p> </div> <div style="text-align: left;"> <p><i>a – Already grafted rootstock being waxed for prevention of moisture loss/entry</i></p> <p><i>b – Grafted, taped and waxed rootstock ready</i></p> </div> </div>
Justification	Graft failures in the field or nursery may sometimes require repeat grafting. Sometime these stocks have not reached the diameter for top working and have exceeded the other sizes. In such cases, splice method is the most appropriate
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Nursery owners, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release the developed management practices</li> <li>• A platform for interaction of macadamia value chain</li> </ul>

	<p>stakeholders</p> <ul style="list-style-type: none"> <li>• Development of good seed systems to backstop community and rural nurseries</li> <li>• Seedling availability and accessibility through macadamia research to develop new varieties</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote seedling production</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) for capacity building</li> <li>• Nursery owners for quality macadamia seed multiplication</li> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs to take up macadamia seedlings production e.g. MESPT, for farmer organization and mobilization</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low use of suitable seed nuts for macadamia rootstock development</li> <li>• Lack of knowhow by nursery operators</li> <li>• Unwillingness of farmers/nursery operators to procure quality seed nuts</li> <li>• Limited number of nurseries willing to propagate macadamia</li> <li>• Low graft takes in macadamia</li> <li>• Low use of good agronomic practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Train farmers/nursery operators on seed selection, use of correct media and empower their ability to access good seed nuts</li> <li>• Research to develop high yielding superior varieties with quality seed nuts</li> <li>• Information dissemination on importance of using good seed nuts to increase yield</li> <li>• Involve County governments, extension, and seed companies</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations</li> <li>• Availability of market is key</li> </ul>

Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on use of macadamia nuts on nutritional importance of the crop in consideration to the social cultural set up of the target communities.</li> <li>• Harmonious gender and social consideration in research, consumption and marketing.</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability. .</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 285 per seedling=285,000/1,000seedling
Estimated returns	KES 400,000 per 1,000 seedlings. Returns =KES 115,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The running of nurseries and handling of specialized tools seems to more of the Men and youth dominated comared to women</li> <li>• All genders have equal opportunities except that nurseries being capital intensive, Women and youth may not access resources for this, particulary if the source is within the household</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth as tree servicer providers in tree grafting as well as transporting the produce to the market</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the VMG as skilled service providers as the operations are not labour intensive</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Nurseries</li> <li>• Private Nurseries</li> <li>• Increased uptake of KALRO macadamia grafted seedlings</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling

<b>G. Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O BOX 220- 01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
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<b>2.2.5 TIMP Name</b>	<b>Bark Grafting Method Or Top Working</b>
<b>Category (i.e. technology, innovation or management practice)</b>	<p><b>Technology</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center;"><i>a</i>                      <i>b</i></p> <p><i>a – Taping scions on the old trunk during a top working session</i></p> <p><i>b - Well taken graft of a top worked macadamia tree</i></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	
What is it? (TIMP description)	The method is done by cutting back the tree trunk to a reasonable height ,one meter above the soil surface..The cut surface is cleaned to expose the cambium layer and ear-mark positions for scion wood. The bark is loosened for scion insertion.The scion is prepared and inserted like that of side wedge method
Justification	This is the most popular method used in in the field to change cultivars from low yielding to high quality and high yielding cultivars
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Nursery owners, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On farm and on station research trials and</li> </ul>

	<p>demonstrations</p> <ul style="list-style-type: none"> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release the developed management practices</li> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Development of good seed systems to backstop community and rural nurseries</li> <li>• Seedling availability and accessibility through macadamia research to develop new varieties</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote seedling production</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) for capacity building</li> <li>• Nursery owners for quality macadamia seed multiplication</li> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs to take up macadamia seedlings production e.g. MESPT, for farmer organization and mobilization</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low use of suitable seed nuts for macadamia rootstock development</li> <li>• Lack of knowhow by nursery operators</li> <li>• Unwillingness of farmers/nursery operators to procure quality seed nuts</li> <li>• Limited number of nurseries willing to propagate macadamia</li> <li>• Low graft takes in macadamia</li> </ul>

	<ul style="list-style-type: none"> <li>• Low use of good agronomic practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Train farmers/nursery operators on seed selection, use of correct media and empower their ability to access good seed nuts</li> <li>• Research to develop high yielding superior varieties with quality seed nuts</li> <li>• Information dissemination on importance of using good seed nuts to increase yield</li> <li>• Involve County governments, extension, and seed companies</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations</li> <li>• Availability of market is key</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on use of macadamia nuts on nutritional importance of the crop in consideration to the social cultural set up of the target communities.</li> <li>• Harmonious gender and social consideration in research, consumption and marketing.</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability. .</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 285 per seedling=285,000/1,000seedling
Estimated returns	KES 400,000 per 1,000 seedlings. Returns =KES 115,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The running of nurseries and handling of specialized tools seems to more of the Men and youth dominated comared to women</li> <li>• All genders have equal opportunities except that nurseries being capital intensive, Women and youth may not access resources for this, particulary if the source is within the household</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth as tree servicer providers in tree grafting as well as transporting the produce to the market</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> <li>• This particular TIMP involves traveling out in the field to top work existing trees, which maybe be difficult for VMG’s</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the VMG as skilled service providers as the operations are not labour intensive</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous	<ul style="list-style-type: none"> <li>• KALRO Nurseries</li> </ul>



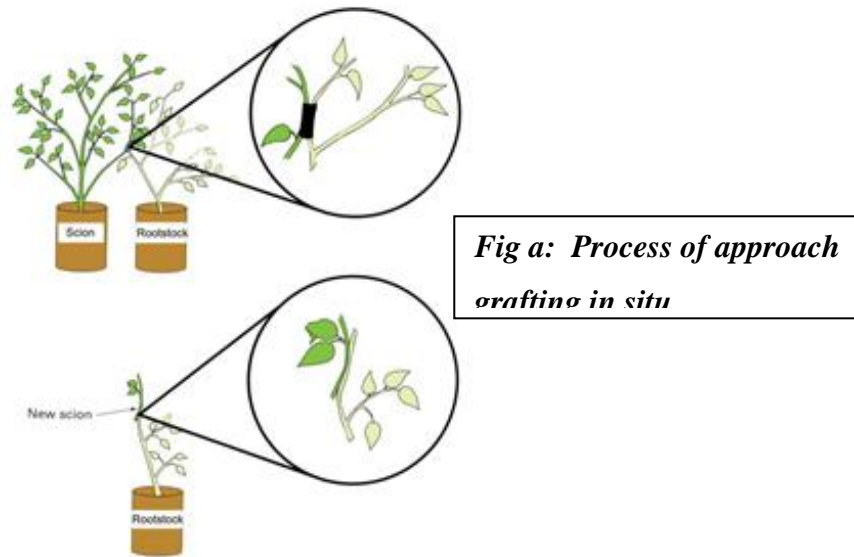
**A: Description of the technology, innovation or management practice**

Problem to be addressed

This is a method commonly used when standard grafts have not been successful and particularly when large number of resultant seedlings are not required. It is an important method when grafting of important materials such as research materials where there is only a limited number of rootstocks.

What is it? (TIMP description)

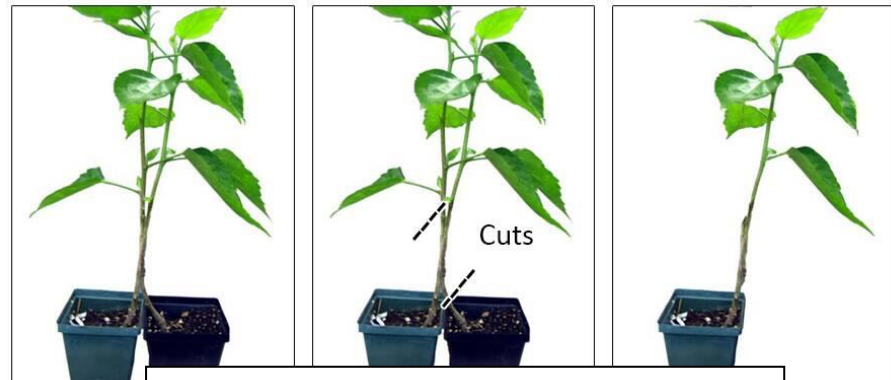
Approach grafting is unique because both the rootstock and scion remain attached to their root systems during the grafting process. The scion is usually in a container, which is brought to the rootstock (fig a below).



Source: <https://hort.ifas.ufl.edu/>

This graft is done while both partners are actively growing. It is a graft used when the scion is unique and the propagator does not want to remove it from the stock plant.

In some cases, both rootstock and scion maybe in in pots or containers (fig b below) but the methodology is almost similar. The graft made by joining stock and scion laterally at an intermediate point but leaving both rooted and uncut until firm union is established when the stock is cut above and the scion below the union.



**Fig b: Process of Approach Grafting in pots**

Source: <https://hort.ifas.ufl.edu/>

Justification	Where a few seedlings are required, it is an appropriate method where the risks of graft failure has serious implications. It is also an easy method by farmers who want to add a few more seedlings to their farms
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Nursery owners, Researchers, Extension service providers.</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On farm and on station research trials and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release the developed management practices</li> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Development of good seed systems to backstop community and rural nurseries</li> <li>• Seedling availability and accessibility through macadamia research to develop new varieties</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to research, validate and promote seedling production</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) for capacity building</li> <li>• Nursery owners for quality macadamia seed multiplication</li> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs to take up macadamia seedlings production e.g. MESPT, for farmer organization and mobilization</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low use of suitable seed nuts for macadamia rootstock development</li> </ul>

	<ul style="list-style-type: none"> <li>• Lack of knowhow by nursery operators</li> <li>• Unwillingness of farmers/nursery operators to procure quality seed nuts</li> <li>• Limited number of nurseries willing to propagate macadamia</li> <li>• Low graft takes in macadamia</li> <li>• Low use of good agronomic practices</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Train farmers/nursery operators on seed selection, use of correct media and empower their ability to access good seed nuts</li> <li>• Research to develop high yielding superior varieties with quality seed nuts</li> <li>• Information dissemination on importance of using good seed nuts to increase yield</li> <li>• Involve County governments, extension, and seed companies</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations</li> <li>• Availability of market is key</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on use of macadamia nuts on nutritional importance of the crop in consideration to the social cultural set up of the target communities.</li> <li>• Harmonious gender and social consideration in research, consumption and marketing.</li> <li>• It is an already “a climate change ready crop” due to its wide adaptation ability.</li> <li>• Enabling policy and policy review from time to time</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 285 per seedling=285,000/1,000seedling
Estimated returns	KES 400,000 per 1,000 seedlings. Returns =KES 115,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The running of nurseries and handling of specialized tools seems to more of the Men and youth dominated comared to women</li> <li>• All genders have equal opportunities except that nurseries being capital intensive, Women and youth may not access resources for this, particulary if the source is within the household</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth as tree servicer providers in tree grafting as well as transporting the produce to the market</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources (i.e. land, credit, and quality seeds) than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the VMG as skilled service providers as the operations are not labour intensive</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar	<ul style="list-style-type: none"> <li>• KALRO Nurseries</li> <li>• Private Nurseries</li> </ul>

projects	<ul style="list-style-type: none"> <li>• Increased uptake of KALRO macadamia grafted seedlings</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G. Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O BOX 220- 01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

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

<b>2.3.1. TIMP Name</b>	<b>Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Macadamia Value Chain in Kenya</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The presence of chemical, biological and physical hazards in the Macadamia value chain in Kenya have a direct effect on consumer's health thereby constantly increasing demand for high quality of the crop and it's by products from consumers and public health departments in counties. These hazards have direct economic consequences affecting families, communities and industries subsisting on the Macadamia value chain in Kenya. This ultimately leads to reduced productivity of the active population in the country. The biological contaminations previously reported on this value chain include presence of <i>Escherichia coli</i> (E. coli), <i>Salmonella</i>

	spp., <i>Aspergillus flavus</i> and <i>Aspergillus parasiticus</i> . The chemical hazards due to heavy metal accumulations like lead/mercury/cadmium and MRLs above permitted levels from pesticides have also previously been detected. These hazards cause neurological disorders, cancer and birth defects to the consumers in the value chain.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in Macadamia 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 Macadamia 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 Macadamia value chain a wholesome and safe Macadamia value chain can be maintained improving on trade and health within and without Kenya borders.
Justification	The only important tool kit to assure food safety through monitoring in the Macadamia 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 Macadamia value chain process, ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer. Through its application, food safety charts in the Macadamia value chain will easily be identified through critical control points. This will set limitation values for monitoring so that action can be taken if the set point values of hazards are out of the defined range required. In this Macadamia value chain, the proposed FSMS that will be adopted, different hazards would be minimized in every phase of production, harvesting, processing, distribution and consumption making Macadamia safe for consumption by Kenyans. Key elements will be identified that will be used or modified to reduce hazards formation in all steps of production to consumption.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia value chain actors from farmers, traders, food vendors and consumers.

<p>Approaches used in dissemination</p>	<ul style="list-style-type: none"> <li>• The entire Macadamia value chain will be evaluated by determining contamination hazards in primary production systems and available control methods for; <ul style="list-style-type: none"> <li>○ Chemical, physical and biological contaminants;</li> <li>○ Knowledge on production and post-harvest systems;</li> <li>○ Experience in implementation of Intergrated Crop Management (ICM) and IPM;</li> <li>○ Experience with principles and practice of HACCP;</li> <li>○ GAP, Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP);</li> <li>○ Knowledge of the target market demands on safety.</li> </ul> </li> <li>• This HACCP information generated and built on seven principles and actions, i.e; <ul style="list-style-type: none"> <li>○ Conduct of hazard analysis and identification of preventive measures</li> <li>○ Identification of critical control points (CCPs)</li> <li>○ Establishment of critical limits for monitoring of each CCP</li> <li>○ Establishment of corrective action in the event of a deviation from a critical limit</li> <li>○ Establishment of record keeping</li> <li>○ Establishment of verification procedures</li> </ul> </li> <li>• This will be used by stakeholders to address the hazard problems along the Macadamia value chain in Kenya.</li> <li>• Dissemination of this generated information will be done through;</li> <li>• The national and county level, common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).</li> </ul>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• For successful promotion of food safety management system through HACCP in the Macadamia value chain; <ul style="list-style-type: none"> <li>○ An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the cashew nut growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards will be formulated.</li> <li>○ Distribution of the printed HACCP plan to Macadamia value chain actors for implementation in order to reduce hazards.</li> </ul> </li> </ul>
<p>Partners/stakeholders for scaling up and their respective roles.</p>	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Systems (NARS) and International research organizations</li> </ul>

	<ul style="list-style-type: none"> <li>• Market players to create a demand and pull production</li> <li>• Farmers/farmer groups to adopt and produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs for farmer organizing and mobilization e.g. SACDEP</li> <li>• Seed companies for quality seed multiplication</li> <li>• Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions</li> <li>• Institutions with IPM and Intergrated Crop Management (ICM) programs</li> <li>• Institutions responsible for legislating in food safety, regulations and sale of pesticides</li> <li>• Institutions with the required analytical testing</li> <li>• Training institutions with extension programs to producers and other actors on the chain</li> <li>• Producers and exporters associations.</li> <li>• Processors and local traders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted. if any	<ul style="list-style-type: none"> <li>• Not promoted in any county of Kenya</li> </ul>
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> <li>• All counties growing and consuming Macadamia in Kenya.</li> </ul>
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Inadequate funds to reach value chain actors</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Funding of dissemination platforms</li> </ul>
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> <li>• The value chain of cashew nut in Kenya is willing to adopt the HACCP plan if well engaged.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in cashew nut value chain.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Issues of food safety are important particularly for women who play a crucial role in the handling of food, storage and delivery to the market</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• The youth are particularly apt to opportunities in training on the food safety issues</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who</li> </ul>


	<ul style="list-style-type: none"> <li>are elderly and disabled</li> <li>• VMGs may have less access to markets</li> <li>• VMGs have limited access to land for macadamia cultivation than men</li> <li>• VMGs may have less access to credit</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in the provision of finances to VMGs</li> <li>• Increased production will lead to increased consumption and utilization of macadamia hence improved health of VMGs</li> </ul>
<b>○ E: Case studies/profiles of success stories</b>	
Success stories	Training of producers by NUTPAK on the harvesting and storage of nuts has reduced incidences of nut rejection due to spoilage
Application guidelines for users	<p>KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</p> <ul style="list-style-type: none"> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling;
<b>○ G: Contacts</b>	
Contacts	<p>Officer in Charge, KALRO Practical Training Centre  E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>  The Institute Director, KALRO-HRI Thika;  E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>  The Centre director, KALRO-Muguga  Email: <a href="mailto:kalro.FCRC@kalro.org">kalro.FCRC@kalro.org</a>  The Centre director, KALRO-Kabete;  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>  The Institute director, KALRO-FCRI Kitale;  E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>
Lead organization and scientists	<ol style="list-style-type: none"> <li>1. Mr. John N. Ndung'u, FCRI - KALRO Njoro</li> <li>2. Mr. Athony Nyaga, KALRO PTC</li> <li>3. Dr. Francis Wayua, KALRO Kakamega</li> <li>4. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters</li> <li>5. Mrs. Violet Kirigua, KALRO Headquarters</li> <li>6. Beatrice Wanjiku, KALRO Njoro</li> </ol>
Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

<b>2.3.2. TIMPs name</b>	<b>Good Agricultural Practices (GAP) for Macadamia</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>• Declining food safety</li> <li>• Reduced food quality</li> <li>• Sustainable farming practices</li> <li>• Reduced environmental impact</li> <li>• Worker safety and health</li> <li>• Traceability</li> </ul>
What is it? (TIMP description)	<p>The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely.</p> <p>It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards.</p> <p>It is not about a specific crop production but the process through which production takes.</p>
Justification	<p>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</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	All Macadamia value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy support frFFBSom government
Partners/stakeholders for scaling up and their roles	Producer organizations, NGO's, MoA, Private extension providers, Council of Governors and other value chain players
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if	None

any	
Counties where TIMP will be up scaled	All counties in Kenya where Macadamia is produced and consumed
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack/inadequate knowledge on the benefits GAPs</li> <li>• Lack of legislative mechanisms to support the GAP, in particular the domestic scope</li> <li>• The perception that GAP is oppressive rather than supportive</li> </ul>
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in upscaling, if any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• 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 than the men in small scale holdings. This means that adaption of GAPs will increase the benefits of good health to the women and those who work more on the farm</li> <li>• Women and youth have limited access to land for macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as seeds than men.</li> <li>• Women and youth may have less access to credit than men</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Proper application of GAP will led to improved health of the various gender categories such as women</li> <li>• Opportunities for youths and men exists in macadamia production and marketing</li> </ul>
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> <li>• Requires a lot of movement on the farm to maintain records and process verification which</li> </ul>

adoption and scaling up	<p>may be untenable by some VMGs who are elderly and disabled</p> <ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and those recovering from drugs exists in macadamia production and marketing</li> <li>• Increased production will lead to increased consumption and utilization of macadamia hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Training of producers by NUTPAK on the harvesting and storage of nuts has reduced incidences of nut rejection due to spoilage
Application guidelines for users	<p>KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</p> <ul style="list-style-type: none"> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<p>Officer in Charge, KALRO Practical Training Centre  E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>  The Institute Director, KALRO-HRI Thika;  E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>  The Centre director, KALRO-Muguga  Email: <a href="mailto:kalro.FCRC@kalro.org">kalro.FCRC@kalro.org</a>  The Centre director, KALRO-Kabete;  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>  The Institute director, KALRO-FCRI Kitale;  E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>
Lead organization and scientists	KALRO: Nyaga A., Ndung'u, J., Wayua, F., Wasilwa, L and Kirigua, V.
Partner organizations and their roles	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.


## 2.4 Macadamia Agronomic Practices

2.4.1 TIMP Name	Site Selection
Category (i.e. technology, innovation or management practice)	Management Practice 
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Identification of suitable areas of growing macadamia
What is it? (TIMP description)	The suitable areas for Macadamia growing ranges from 1,250-1,900m above sea level, with an annual rainfall range of 1,200-1,800 mm. These areas must be frost free, with an optimum temperature of 15-28°C. The soils must be well drained and rich in organic matter (100 cm depth). The optimum Soil pH range is 5.0 – 6.0. The Slope of the land should not exceed 20 degrees
Justification	Macadamia varieties are specific to agro-ecological zones where they are suitable. Growing a variety in the wrong zone results in poor yields, quality and wastage of resources.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and procesors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> </ul>

	<ul style="list-style-type: none"> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> </ul>
	<ul style="list-style-type: none"> <li>• Extension service providers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to land than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Macadamia trees are considered men's enterprises thereby limiting women control</li> </ul>

	<p>and benefit from them</p> <ul style="list-style-type: none"> <li>• Men may make decisions on site selection because they usually are dominant decisions at the household and community</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for men, youth and women exist in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii, Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>


	<p>The Centre director, KALRO-Kabete;  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>  The Institute director, KALRO-FCRI Kitale;  E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>
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2.4.2 TIMP Name	Land Preparation
<b>Category (i.e. technology, innovation or management practice)</b>	Management Practice 
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	In appropriate land preparation practices
What is it? (TIMP description)	The initial land preparation is done during the dry season by either ploughing, harrowing, use of herbicides or methods stipulated in conservation agriculture. The planting holes dimensions are a minimum of 60cm wide and 60cm depth. Filed spacing is maintained at a minimum of 7.5m x 7.5m for pure stand and atleast 10m x 10m or larger depending on intercrop. During hole preparation, the top and sub soils are separated. Manure (atleast 2 debes) is mixed with with the top soil and then filled back into the hole. Erosion prevention measures must be put in place at this land preparation stage
Justification	Improper land preparation leads to poorly established crop as the crop has a poorly established root system hence the need have proper planting holes and clear area during establishment.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and procesors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>

successful promotion	
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in	<ul style="list-style-type: none"> <li>• Land preparation is traditionally a man's</li> </ul>

development dissemination, adoption and scaling up	<p>activity</p> <ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Macadamia trees are considered men's enterprises thereby limiting women control and benefit from them</li> <li>• Men dominate decisions on macadamia at the household and community</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for men and youth exist in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.

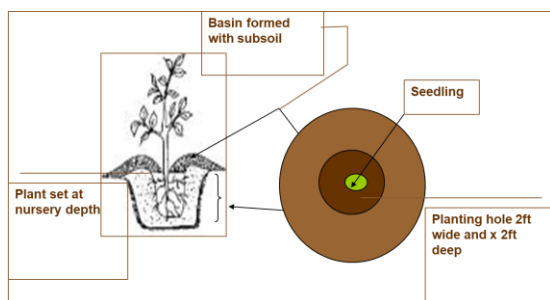
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>
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<b>2.4.3 TIMP Name</b>	<b>Spacing and Orchard establishment</b>
Category (i.e. technology, innovation or management practice)	Management Practice 

**A: Description of the technology, innovation or management practice**

Problem to be addressed	Incorrect spacing and improper planting methods leads to poor yields and low nut quality leading to poor returns to the producers
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**What is it? (TIMP description)**



An optimum spacing of 7.5m x 7.5m (for pure stand) and a minimum of 10m x 10m with intercrops is recommended.

**Planting**

Top soil and sub soil should be to be kept separately during hole preparation

Mix the top soil with one debe FYM & a handful (150 grams) of compound fertilizer e.g. 17:17:17. Mix thoroughly and fill the mixture back into the planting hole.

Remove seedling from potting bag carefully without disturbing the roots.

Make a small hole on the backfilled soil of similar size to the seedling soil root mass

Cover the seedling with soil ensuring the nursery soil level on the seedling is maintained.

A basin can be made around the newly planted seedling to help in water retention


Sub-soil is then used to make a basin around the seedling for holding water

Water the seedling after planting. It is always

	advisable to establish the crop at the beginning of the rainy season
Justification	Macadamia being a perennial crop with a bearing life of over 80 years requires proper spacing to avoid competition of nutrients. Initial proper establishment of seedlings is very essential for good growth system
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and processors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
	<ul style="list-style-type: none"> <li>•</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> </ul>

	<ul style="list-style-type: none"> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Macadamia trees are considered men's enterprises thereby limiting women control and benefit from them</li> <li>• Men dominate decisions on macadamia at the household and community</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for men, youth and women exist in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been</li> </ul>

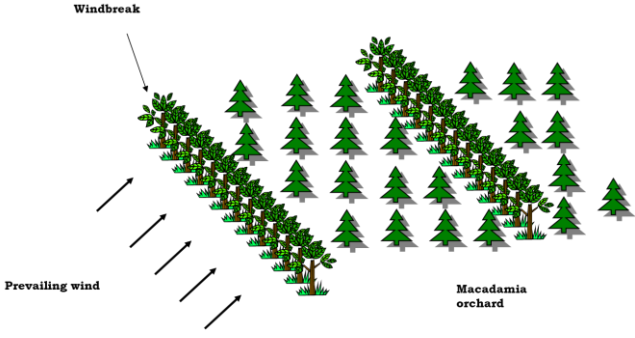
projects	adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

<b>2.4.4 TIMP Name</b>	<b>Staking</b>
Category (i.e. technology, innovation or management practice) Manage	<p><b>Management Practice</b></p>  <p><i>A well staked young seedling</i></p>
<b>A: Description of the technology, innovation or management practice</b>	

Problem to be addressed	Lodging of young trees due to wind and poor root system
What is it? (TIMP description)	<p>Staking is the erection of support mechanisms of the young seedlings by use of sticks and strings to avoid lodging.</p> <ul style="list-style-type: none"> <li>• Staking is done immediately transplanting, immediately</li> <li>• The seedling is tied on straight sticks to prevent them from lodging especially in windy places</li> <li>• Watering should be done immediately after staking to reduce stress to the young plant</li> </ul>
Justification	Macadamia has a poorly developed rootsystem particularly at a young seedling stage. This leads to the seedlings easily lodging if there strong winds or heavy rains. Staking supports the seedling before a proper root system develops for anchoring
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and procesors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
	<ul style="list-style-type: none"> <li>•</li> </ul>
<b>C: Current situation and future scaling up</b>	



Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Macadamia trees are considered men's enterprises thereby limiting women control and benefit from them</li> <li>• Men dominate decisions on macadamia at the household and community</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for men, youth and women exist in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of</li> </ul>

	awareness
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

2.4.5 TIMP Name	Erection of Windbreaks
Category (i.e. technology, innovation or management practice)	<p><b>Management Practice</b></p> 
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Lodging of macadamia seedlings and mature trees
What is it? (TIMP description)	Live Wind breaks of compatible tree types (eg cypress, grevilia) are planted at least one year before establishing an orchard. The trees are planted perpendicular to the direction of the wind
Justification	Wind breaks recommended in areas with strong winds because of macadamia inherently poor root structure and formation. Wind break reduces wind's velocity and therefore prevent macadamia trees form lodging
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and procesors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> </ul>

	<ul style="list-style-type: none"> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
	<ul style="list-style-type: none"> <li>•</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Macadamia trees are considered men's enterprises thereby limiting women control and benefit from them</li> <li>• Men dominate decisions on macadamia at the household and community</li> </ul>

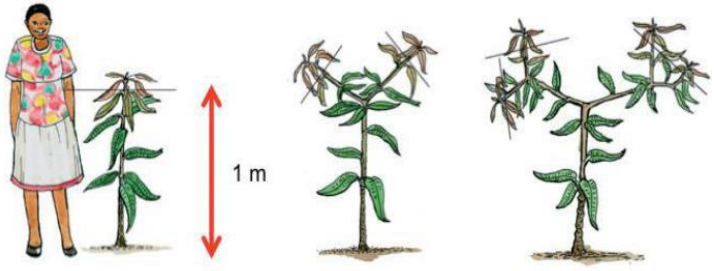
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for men, youth and women exist in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii, Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

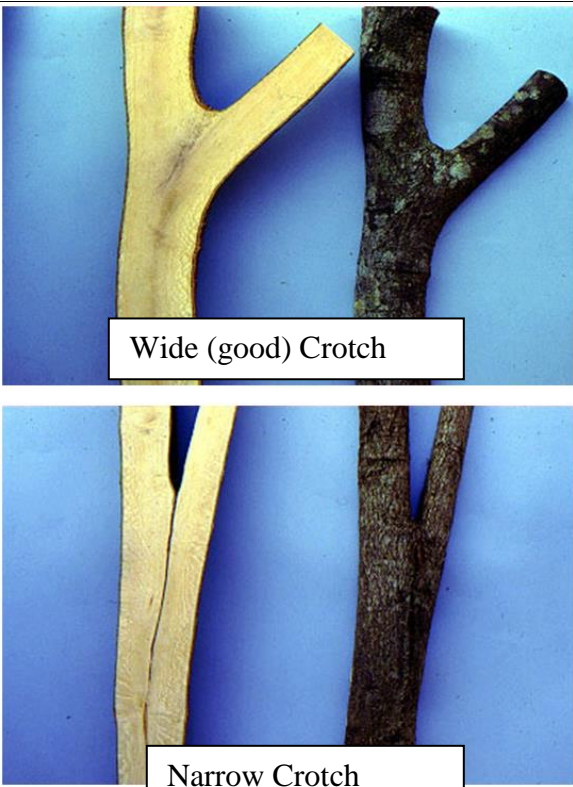
<b>2.4.6 TIMP Name</b>	<b>Intercropping</b>
Category (i.e. technology, innovation or management practice)	<p><b>Management Practice</b></p>  <p><i>Macadamia intercropped with coffee</i></p>  <p><i>Macadamia intercropped with legumes, napier grass, passion fruit, bananas in a mixed cropping system</i></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Increasing productivity and resilience in land while at the same time conserving the soils and increasing biodiversity
What is it? (TIMP description)	Macadamia can be intercropped with annuals when young and also with trees , such as coffee, grievé lea among others as long they are well spaced
Justification	Intercropping macadamia with annuals such as legumes will improve the soil fertility (nitrogen fixation) while the trees will improve shading and increase the gross margin per unit area.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and procesors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> </ul>

	<ul style="list-style-type: none"> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women and youth have limited access to the</li> </ul>

	<p>equipment used to make the water pan than men</p> <ul style="list-style-type: none"> <li>• Women have less access to land that can be used for water pan than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Intercropping offers good opportunities to both men and women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• 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</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O Box 220-01000, Thika

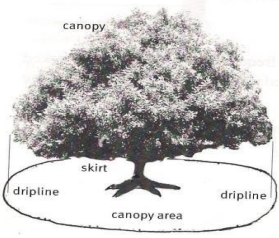

Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
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<b>.4.7 TIMP Name</b>	<b>Pruning</b>
Category (i.e. technology, innovation or management practice)	<p><b>Management Practice</b></p> <p><b>Formative pruning to achieve the desired shape</b></p> 
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Formatting of trees
What is it? (TIMP description)	Trees are capped at 80-100cm to promote branching with lateral branches too close to the ground being removed. Branches with narrow crotch angles are removed to leave only those with wide crotch angles

	 <p>Wide (good) Crotch</p> <p>Narrow Crotch</p>
Justification	Unwanted growth is removed so as to stimulate desired growth and open up the tree. It is important for nut development and also reduction of insect infestation
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Producers, nursery operators and other value chain players such as extension service providers, policy makers at county and national level and procesors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> </ul>

	<ul style="list-style-type: none"> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
	<ul style="list-style-type: none"> <li>•</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia and give maximum profitability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 28,400 per acre
Estimated returns	KES 479,000 per acre. Returns =KES 468,400
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth may have less access to productive resources such as credit, labour and quality seedlings and farm implement than men</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men have limited access to land for macadamia production than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for men and youths in performing the operation</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGshave less access to productive resources such as credit, labour, quality seedlings and farm implement than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than menen have limited access to land for macadamia production than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for and youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Production Manuals</li> <li>• Brochures</li> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya, A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara, P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

2.4.8 TIMP Name	<b>Fertilizer Application</b>																																												
Category (i.e. technology, innovation or management practice)	<b>Management Practice</b> 																																												
<b>A: Description of the technology, innovation or management practice</b>																																													
Problem to be addressed	Inappropriate application of fertilizer and Nutrient deficiency																																												
What is it? (TIMP description)  A well maintained orchard with good nutrition	<p>Application of fertilizer or manure is done just before the rains. It is done along the plant drip line as that is where the feeding roots are. The quantities applied is is per the soil analysis recommendations. Where the recommendations lack, the table below gives a general guideline. If soil pH is below 4.5, lime (calcium carbonate) &amp; single super-phosphate is mixed with soil at each planting hole. Where Manure is used, two debes of manure during the main rainy season are sufficient for a 10 year old tree.</p> <p><b>Table showing Recommended Fertilizer Rates (g) (NPK 17:17:17)</b></p> <table border="1"> <thead> <tr> <th>Year</th> <th>Long Rains (April)</th> <th>Short Rains (October)</th> <th>Total</th> </tr> </thead> <tbody> <tr><td>1</td><td>30</td><td>30</td><td>60</td></tr> <tr><td>2</td><td>30</td><td>30</td><td>60</td></tr> <tr><td>3</td><td>83</td><td>83</td><td>166</td></tr> <tr><td>4</td><td>115</td><td>115</td><td>230</td></tr> <tr><td>5</td><td>300</td><td>300</td><td>600</td></tr> <tr><td>6</td><td>600</td><td>600</td><td>1200</td></tr> <tr><td>7</td><td>900</td><td>900</td><td>1800</td></tr> <tr><td>8</td><td>1200</td><td>1200</td><td>2400</td></tr> <tr><td>9</td><td>1350</td><td>1350</td><td>2700</td></tr> <tr><td>10</td><td>1350</td><td>1350</td><td>2700</td></tr> </tbody> </table>	Year	Long Rains (April)	Short Rains (October)	Total	1	30	30	60	2	30	30	60	3	83	83	166	4	115	115	230	5	300	300	600	6	600	600	1200	7	900	900	1800	8	1200	1200	2400	9	1350	1350	2700	10	1350	1350	2700
Year	Long Rains (April)	Short Rains (October)	Total																																										
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7	900	900	1800																																										
8	1200	1200	2400																																										
9	1350	1350	2700																																										
10	1350	1350	2700																																										
Justification	Inmproper and inadequate application of crop nutrients in Macadamia leads to low yields and poor quality and the destruction of the soil nutrient balance.																																												
<b>B: Assessment of dissemination and scaling up/out approaches</b>																																													
Users of TIMP	Macadamia Producers, nursery operators and other																																												

	value chain players such as extension service providers, policy makers at county and national level and processors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• ToT</li> <li>• demonstrations</li> <li>• Farmer Field and Business School Approach</li> <li>• Innovation Platforms</li> <li>• Field days and Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Demonstrations , farmer exchange visits</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• National government for promotion, policy and allocation of funds</li> <li>• County governments (funding &amp; promoting the crop)</li> <li>• NARIs (R&amp;D and training)</li> <li>• NGO's (Training &amp; funding)</li> <li>• CBO's</li> <li>• Lead Farmers</li> <li>• Extension service providers</li> </ul>
	<ul style="list-style-type: none"> <li>•</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Adopted by some farmers in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta
Counties where TIMP will be up scaled	Meru, Nyanza and Western regions, North Rift and other emerging suitable macadamia growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of adequate quality seedlings</li> <li>• Lack of correct agronomic knowledge by producers</li> <li>• Unavailability of sufficient amount of water for irrigation where required</li> <li>• Lack strong farmers grower organizations &amp; CBO's</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization on importance planting healthy and vigor seedlings</li> <li>• Digging of bore holes</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Growing macadamia in the recommended agro-ecological can enhance both productivity and quality</li> </ul>
Social, environmental, policy and market conditions necessary for	<ul style="list-style-type: none"> <li>• This technology will enable growing of macadamia</li> </ul>

development and upscaling	and give maximum profitability
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth may also have limited access to finances to buy the required inputs such as fertilizers than men.</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for youths in performing the operation</li> <li>• Employment opportunity exist for youths in transporting fertilizers from the agrovets to the end users</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Some VMGs are physically disadvantaged for a practice</li> <li>• VMGs have limited access to land for macadamia cultivation than men</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as fertilizers than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in various areas as for instance in the provision of finances for farming to VMGs</li> <li>• Employment opportunity exist for youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Macadamia orchard establishment has been adopted in Muranga, Kiambu, Nyeri, Nyandarua, Embu, Meru, Machakos, Bungoma, Kisii , Kericho, Bungoma, Busia and Taita Taveta</li> </ul>
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<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-requires validation; 3-requires further research)	<ul style="list-style-type: none"> <li>• Ready for upscaling</li> </ul>
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kandara,

	P.O. Box 220-01000, Thika
Lead organizations and scientists	KALRO Scientists Watani G., Antony N., Kiiru S., Muriuki SJN., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcri@kalro.org">director.fcri@kalro.org</a>

## 2.5 Macadamia Soil Fertility Management

<b>2.5.1 Technology name</b>	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health. Poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description)	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure starting at collection, treatment, storage and its 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 22kg/ha for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the nutrients (macro and micro) in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health leading to increased agricultural productivity, improved soil physical properties and promotes biodiversity. Given the low use and limited access to mineral fertilizers, manure has the potential of providing the limiting nutrients for increased crop productivity at a relatively low cost.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches used in dissemination	Open and field days Exchange visits Demonstration farms

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Training on handling, management and use of manure</li> <li>• Dissemination approach used to reach target farmers</li> <li>• Model demonstration plots using fruit tree crops</li> </ul>
Partners/stakeholders for scaling up and their roles	County governments, provide extension services, farmer mobilization and policy formulation, ILRI, technical backstopping NGOs – micro financing services
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	-
Counties where TIMP will be promoted	Meru county and other counties with suitable climatic conditions for Macadamia production
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of model demonstration farms</li> <li>• Lack of continuity in training of extension and farmers in the skill for manure management</li> <li>• Lack of proper mobilization mechanism for reaching many farmers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establishment of many demonstration plots by county governments</li> <li>• Capacity building communities' on manure management and its benefits</li> <li>• Continuous capacity building of demonstration farmers and extension workers</li> <li>• Use of approaches to mobilize farmer to attend demonstration forums</li> </ul>
Lessons learned if any	<ul style="list-style-type: none"> <li>• Proper use of manures improves soil fertility</li> <li>• Use of manures enhances crop productivity</li> <li>• Skills in manure preparation, storage and application</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water.</li> <li>• Propagation of invasive species when the seed is ingested by the animal and passed to crop field</li> <li>• Manure can harbor pathogens which can cause disease outbreaks to livestock</li> <li>• Contamination of water sources by leaching of nutrients</li> <li>• Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Proper handling of manure needs intensive labour for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time

	Using locally available manure/composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practiced
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have limited access to farm inputs such as manures than men</li> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for water pan than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women can have opportunities in manure application and earn an extra income</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to farm inputs such as manures than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Unemployed youths can have opportunities in manure application and earn an extra income</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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	<p>The guideline focuses on the following areas:</p> <ul style="list-style-type: none"> <li>• Animal feeds</li> <li>• Livestock housing and manure collection</li> <li>• Manure storage to preserve nutrient and avoid loses</li> <li>• Manure treatment for ease of transport and application in the field</li> <li>• Timing of application for maximum utilization by the crop</li> <li>• Anaerobic digestion for biogas production</li> <li>• Regular analysis of manure to ascertain the quality</li> <li>• Manure/Composts take a long time to cure, hence</li> </ul>

	need good planning prior to use
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamungo, A.O. Esilaba, F.M. Wandera
Partner organizations	County government, Private Public Partnerships

### Research gaps

1. Promote IMM complementary technology in counties with low adoption.
2. Conduct nutrient budget study on selected farms utilizing manures (including composts) in target counties.

<b>2.5.2. TIMP name</b>	<b>Integrated Soil Fertility Management (ISFM)</b>
Category (i.e. technology, innovation or management practice)	Complementary technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem 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 Kenya are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. However younger volcanic are inherently richer in nutrients, but exhibit soil fertility problems soil acidity and nutrient fixation. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil

	management that include fertilizer use and crop agronomy. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Training in workshops</li> <li>• On-farm visits</li> <li>• Farmer field schools (FFS)</li> <li>• On-farm demonstrations (during FFS)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of affordable and quality manure, fertilizers and clean planting materials</li> <li>• Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; and</li> <li>• Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.</li> </ul>
Partners/stakeholders for scaling up and their roles	County government extension services; provide link with farmers. Community farmer groups; play coordination role for ease in problem identification and dissemination.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	-
Counties where TIMP will be promoted	Meru and other counties with suitable agro-ecological conditions for Macadamia production
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Change of mindset in some regions/cultures that organic manures cannot be applied on crops</li> <li>• Misconceptions that chemical fertilizer damage the soils</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness trainings on role of organic manures in crop cultivation</li> <li>• Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers</li> </ul>
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings is required since farmers tend to re-use previous planted materials.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Practice is socially acceptable</li> <li>• Environmentally friendly</li> <li>• Increased productivity will provide supply to the markets</li> <li>• Supporting frameworks/policies are available</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	This is a technically demanding technology and costly in areas

	where application of ISFM is non-responsive
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities such as weeding hence the IMM may increase their work burden</li> <li>• Women and youth have limited access to productive resources such as land, quality macadamia cuttings and credit</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for and youth in IMM operations</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality macadamia cuttings</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> <li>• It is labour intensive in terms of handling and application hence may disadvantage VMGs.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in IMM operations</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	ISFM successes have been reported in Macadamia value chains in Meru and Embu county where productivity have been improved
Application guidelines for users	<ul style="list-style-type: none"> <li>• Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients.</li> <li>• Ensure that good agronomic practices are upheld</li> <li>• For sustainability, lone use of inorganic or organic materials should be avoided.</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. O. Esilaba, F.M. Wandera, G.N.Gachini
Partner organizations	County governments KEFRI

## Research Gaps

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

<b>2.5.3. TIMP name</b>	<b>Rapid soil testing services</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>• Conventional methods for soil testing are not cheap to farmers, results take long and not are reproducible.</li> <li>• The methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously.</li> <li>• Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols.</li> <li>• Limited access to soil testing services (centralized soil testing laboratories and cost).</li> </ul>
What is it? (TIMP description)	<p>This is a dry method for soil testing using simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue.</p> <p>It requires partners involved (ICRAF, iSDA and Soil Cares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.</p>
Justification	<p>Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers’ ability to make informed decisions with regard to soil management and fertilizer use.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension officers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Farmer visits</li> <li>• Training in workshops</li> <li>• Publicity campaigns done at County levels.</li> </ul>
Critical/essential factors for successful promotion.	<ul style="list-style-type: none"> <li>• Availability of the necessary equipment for rapid on the spot soil testing.</li> <li>• Established rapport between farmers and the technical personnel involved in soil testing.</li> <li>• Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins.</li> <li>• A well-designed storage system for keeping information obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data and fertilizer</li> </ul>

	<p>recommendation according to crop type suitability). Availability a van to mount the equipment.</p> <ul style="list-style-type: none"> <li>• Farmers must understand, trust, and be willing to act upon the information provided</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension services; providing the link to farmers given that agriculture is devolved.</li> <li>• Soil Cares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF,</li> <li>• ICRAF and iSDA tests and validates the recommendation obtained in collaboration with Soil Cares and KALRO.</li> <li>• Fertilizer companies; To provide fertilizer blends according to soil health status</li> <li>• Agro dealers to stock required fertilizers that is readily available to farmers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	-
Counties where TIMP will be up scaled	Meru and other counties with suitable agro-ecological conditions for water melon production
Challenges in dissemination	<ul style="list-style-type: none"> <li>• It requires continuous updating methods to improve recommendations.</li> <li>• Lack of awareness on the importance of regular testing of soil quality</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation, intensive farmer field training (capacity building)</li> <li>• Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis.</li> <li>• Automated pipelines for updating existing recommendation methods.</li> </ul>
Lessons learned in upscaling if any	Timely affordable soil information will guide on fertilizer use. Farmers report frustration when they apply fertilizers and see no results for lack of understanding soil nutrient requirements for individual crops.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Socially acceptable-brings income, increases food production, nutrition security and family cohesion.</li> <li>• Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water.</li> <li>• Increased productivity will provide supply to the markets</li> </ul> <p>Supporting frameworks/policies are available.</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Soil testing equipment and consumables, sampling and packaging materials, personnel. The actual costs will be determined upon consultation.</li> <li>• Shipping selected soil and plant materials for further testing and results verification in a certified lab.</li> </ul>


Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 30% of current returns and no doubt will be making agronomy great again.
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to credit to pay for the services than men</li> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for water pan than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• By bringing services closer to the users saves time and resources to the farmers (men, women and youth).</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to farm inputs such as credit to pay for the services than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land, credit and quality seed</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Offers employment especially for the youth who could be trained as soil sampling champions and later offer the services to help the local communities</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Has been tested used successfully by other organizations like ICRAF, Soil Cares & KESREF. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugarcane.
Application guidelines for users	<ul style="list-style-type: none"> <li>• A handheld scanner to testing soils and crops in the field</li> <li>• Community soil sampling champions are identified and trained on good soil sampling procedures.</li> <li>• Soil and crop is analyzed and the results including fertilizer recommendation generated on site.</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Requires validation
<b>G: Contacts</b>	

Contacts	Director, Environment & Natural Resources, KALRO secretariat
Lead organization and scientists	KALRO; F. M. Wandera, G. N. Gachini, A. Chek, D. Kamau, A.O. Esilaba
Partner organizations	County governments in the 24 counties, Soil Cares, ICRAF and iSDA

### Gaps:

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

## 2.6 Soil and Water Management

<b>2.6.1 TIMP name</b>	<b>Contour bunds</b>  <i>Contour bunds</i>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off from torrential rains, low soil water retention capacity of soils in dryland ecosystems
What is it? (TIMP description)	Contour bunding involves laying points of equal elevation of stone or soil along the contour of a sloping field followed by constructing a bund or barrier along the contour. Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus, contour bunds resemble narrow channel terraces commonly referred to as “ <i>fanya chini</i> ” terraces. The technology is highly

	suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Contour bunds resemble narrow channel terraces commonly referred to as “ <i>fanya chini</i> ” terraces. The aim of contour bunds and hedgerows is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. This also decreases the risk of erosion. Plants with higher water requirements, such as peas or beans, can be planted on the higher side of the furrow whereas fruit crops requiring less water can be planted on the ridges. Construction of contour bunds is relatively simple and low-cost way to reduce soil degradation.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.</li> </ul>
Most effective approach	Model farm demonstration
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the technology is labour intensive.</li> <li>• Farmers and extension service with skills to design and construct contour bunds.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools.</li> <li>• External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	-
Counties where TIMP will be promoted	Meru and other counties with suitable agro-ecological conditions for water melon production
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if contours are improperly laid out</li> <li>• Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>• Land tenure systems – communal land ownership, or in places where individuals don’t have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate equipment for preparation of Contour for efficiency and increased output per man hour.</li> <li>• Training youthful farmers to be champions of contour bunds construction at the Ward level/village level.</li> <li>• Training on site specific designs and construction of contour</li> </ul>

	<ul style="list-style-type: none"> <li>bunds</li> <li>Fast-track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance.</li> <li>Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>Enforce policies on soil and water conservation at the County level</li> <li>Create awareness on the importance of soil and water conservation</li> <li>Avail low-cost technologies for soil and water conservation</li> <li>Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for <i>contour</i> preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Ownership of or access to land may limit women in some regions</li> <li>Making decisions on land use may limit women in some region where decision making is men dominated</li> <li>Differing accessibility of the technology and information may disadvantage different gender</li> <li>The technology is labour intensive hence may disadvantage women and members who cannot procure labour services</li> <li>Differing accessibility of information between men and women because of gender norms that place access to new information and technologies in the hands of male heads will affect adoption and scaling up.</li> <li>Ownership of or access to land and credit will affect adoption and scaling up.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Increased agricultural production will increase access to food and income among all gender.</li> <li>Potential for employment creation - youthful male and women will provide labour during the implementation of the technology.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Limited of access to information may limit the VMG from technology access and use</li> <li>Limited attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges limits use of technologies.</li> <li>The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> <li>The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling</li> </ul>

	<p>up.</p> <ul style="list-style-type: none"> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• Competing priorities and household decisions might hinder adoption and scaling up.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Application of contour ridge is expected to improve agriculture production thus, more food and income for the VGMs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	-
Application guidelines for users	Soil is excavated up-slope of the bund to a depth of 50 cm. Contour bunds should drain in one direction and can be manually or machine constructed. The length of a bund across a slope should be between 400 to 500 m. The height of a bund should be at least 25 cm and have an approximate spacing of 1-2 m. In arid areas, the distance between bunds can be increased to 5-10 m. Hedgerows grown to stabilize bunds should be spaced at 4 to 8 m across the slope.
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau and F. M. Wandera
Partner organizations	County Government extension offices.

### Gaps for further research

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

<b>2.6.2. TIMP name</b>	<b>Contour Drainage ditches</b>
Category (i.e. technology, innovation)	Management Practice


or management practice)	
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Heavy rainfall, increased surface run off, soil erosion results in surface soil loss leading to exposed fruit tree roots resulting into stem flow run-off and poor tree and nut development due nutrient loss
What is it? (TIMP description)  Zai pits combined with stone rows	Contour drainage ditches drain excess water out of the field, and if with closed ends, retains water for use or infiltration into the downslope fields, by reducing downslope water movement which is collected in the ditch. The structures is mostly useful for small-holder hillside farming since these require less work than terraces, are simple to build, and can be used to either divert or to retain water. They divert excess water to protected drainage ways, reduce soil erosion and leaching of nutrients.
Justification	The impacts of climate change such prolonged heavy rainfall seasons threatens agricultural production, food security and livelihoods especially in high altitude ecosystems. Contour drainage ditches technology has the potential to conserve soil, harvests and store rain water crop use. This technology contributes to restoration and management of degraded lands, reducing soil erosion, vegetation and biodiversity loss as well as crop yields.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups, Agro vets and the County extension offices.</li> </ul>
Most effective approach	Model farm demonstration
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the technology is labour intensive.</li> <li>• Farmers and extension service with skills to design and construct contour drainage ditches.</li> <li>• Availability of affordable organic matter i.e. manure, compost.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension services –delivery of information inputs to farmers.</li> <li>• Community farmer groups – Provide on-farm demonstration plots to hold farmer field schools</li> <li>• NGOs – capacity building, policy support in soil and water conservation issues</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Limited adoption because of the costs involved
Counties where TIMP will be promoted	Meru and other counties with suitable agro-ecological conditions for water melon production
Challenge(s) in development and dissemination	The greatest challenge is that the technology is labour intensive and many farmers may find it difficult to implement at large scale.

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate equipment for preparation of Contour Drainage ditches for efficiency and increased output per man hour.</li> <li>• Training youthful farmers to be champions of Contour Drainage ditches construction at the Ward level/village level.</li> </ul>
Lessons learned, if any	The technology has huge potential to increase farmers' resilience especially in high rainfall locations. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest in it to maximize yields.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Enforcement of policies on soil and water conservation at the County level</li> <li>• Creation of awareness on the importance of soil and water conservation</li> <li>• Provision of low-cost technologies for soil and water conservation</li> <li>• Policies that support individual land tenure systems</li> <li>• Provision of support in the establishment of contour drainage ditches</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for construction of contour drainage ditches. It is estimated at KES 400 to 1000 per contour drainage ditch depending on the length of the slope
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened</li> <li>• Women and youth have limited access to land for macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as farm implements used to perform the operation than men.</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for youth during implementation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for macadamia cultivation than men</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as seeds than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• The TIMP is expected to improve agriculture production thus, more food and income for the VGMs</li> <li>• Increased production will lead to increased consumption and utilization of macadamias and hence improved health</li> </ul>

	of VMGs
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened</li> <li>• Women and youth have limited access to land for macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as farm implements used to perform the operation than men.</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	Farmers in Kathonzweni, Makueni County contour drainage ditches have been embraced in order to have meaningful yield.
Application guidelines for users	Contour Drainage ditches are 2-3m deep, 2-3m wide and 10-15m along, usually in succession of 7-10m. The Contour Drainage ditches are during the dry season when labour constraints are minimal. The soil from the pit thrown downhill/uphill to form a crescent shaped dam.
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Ketiemi, J. Mwaura; D. Kamau, F. M. Wandera and A.O. Esilaba.
Partner organizations	County Government extension offices.


## GAPS

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

<b>2.6.3. TIMP name</b>	<b>Bench terraces</b>
Category (i.e. technology, innovation or management practice)	Management Practice  Bench Terraces
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)  Bench terraces	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.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the technology is labour intensive.</li> <li>• Farmers and extension service with skills to design and construct contour bunds.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools.</li> <li>• External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Muranga, Machakos, Embu, Kirinyaga, Nyamira Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP	Meru and any other county with suitable agro-ecological conditions


will be promoted	for watermelon production
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if terraces are improperly laid out</li> <li>• Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale</li> <li>• Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour.</li> <li>• Training youthful farmers to be champions of making bench terraces construction at the Ward level/village level.</li> <li>• Training on site specific designs and construction of bench terraces</li> <li>• Fast track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance.</li> <li>• Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>• Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>• Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Enforce policies on soil and water conservation at the County level</li> <li>• Create awareness on the importance of soil and water conservation</li> <li>• Avail low-cost technologies for soil and water conservation</li> <li>• Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for <i>Bench terrace</i> preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope
Estimated returns	The returns depend on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Bench terrace technology is labour intensive therefore may increase women work burden</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Women and youth have limited access to productive resources such as land, quality seed potato cuttings and credit</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Potential to create employment for youth through provision of the labour required</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed potato cuttings</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth exists in provision of labour</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	<p>Mukethe Mbithi is a member of the Kyungu Mwethya group in Machakos</p> <p>"Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed. But when we made terraces the soil erosion stopped and we got good crops. So, I encourage other farmers especially in dry areas to try this new technology for their crops"</p>
Application guidelines for users	<p>Terraces draining in one direction should be at least 100m or more. The length can be slightly increased in arid and semi-arid regions. The width of the bench (flat part) is determined by soil depth, crop requirements, and tools to be used for cultivation. Optimum width of terrace benches ranges from 2.5 to 5 m for manually constructed ones and from 3.5 to 8 m for machine built and tractor-cultivated ones.</p> <p>Terraces should drain runoff along the horizontal gradient of the slope, either in outward or reverse direction. The outward gradient can range from 0.5% in arid or semi-arid regions to 3% in humid regions with clay soils. Maximum gradients can be 5% for reverse terraces. In high rainfall areas (more than 1000 mm annually), it is necessary to make additional drainage provisions off the terraces – although this has a risk of causing erosion on very steep slopes. These additional drainage channels should be trapezoidal in shape and planted with grass to prevent erosion. Machine construction is possible on slopes of 12-36% while manual construction can be used on slopes of 12-47%.</p>
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p>
Lead organization and scientists	<p>KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau, F. M. Wandera</p>
Partner organizations	County Government extension offices.

<b>2.6.4 TIMP name</b>	<b>Fanya Juu Terraces</b>
Category (i.e. technology, innovation or management practice)	Management Practice  Fanya Juu terrace
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	‘Fanya juu’ terraces (juu is Swahili word for ‘up’) are constructed by excavating soil and throwing it up-slope to make an embankment. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as macadamia may then be grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off. Fanya Juu terraces are often used in the highlands where water speed is high
Justification	The impacts of climate change such prolonged heavy rainfall seasons threatens agricultural production, food security and livelihoods especially in high altitude ecosystems. Contour drainage ditches technology has the potential to conserve soil, harvests and store rain water crop use. This technology contributes to restoration and management of degraded lands, reducing soil erosion, vegetation and biodiversity loss as well as crop yields..
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> <li>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the technology is labour intensive.</li> <li>• Farmers and extension service with skills to design and construct contour bunds.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools.</li> <li>• External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru , Nyamira, Trans Nzoia
Counties where TIMP will be promoted	Meru and other counties with suitable agro-ecological conditions for water melon production
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if terraces are improperly laid out</li> <li>• Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>• Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate equipment for preparation of terraces for efficiency and increased output per man hour.</li> <li>• Training youthful farmers to be champions of 'fanya juu' terraces construction at the Ward level/village level.</li> <li>• Training on site specific designs and construction of 'fanya juu' terraces</li> <li>• Fast-track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>• 'Fanya juu' terracing is popular due largely to the rapid benefits it gives in terms of soil and water conservation.</li> <li>• Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>• Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>• Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Enforce policies on soil and water conservation at the County level</li> <li>• Create awareness on the importance of soil and water conservation</li> <li>• Avail low-cost technologies for soil and water conservation</li> <li>• Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for <i>terrace</i> preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology is labour intensive therefore may increase women labour burden</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Women and youth have limited access to productive resources such as land, quality seed potato cuttings and credit</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Potential to create employment for youth through provision of the labour required</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of</li> </ul>

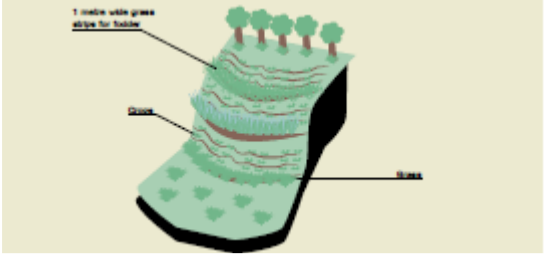
	<p>reach for the VMGs thus affecting adoption and scaling up</p> <ul style="list-style-type: none"> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth exists in provision of labour</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	Over 50,000 smallholder farmers in lower Eastern counties of Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of trenches in hillside to trap runaway water and soil.
Application guidelines for users	The ‘Fanya juu’ trench is 60 cm wide by 60 cm deep, and the bund 50 cm high by 150 cm across 19. In arid regions the trenches can be enlarged to 150 cm deep and 100 cm wide. Distance between bunds can be from 5 m on steep slopes to 20 m on gentle slopes. Stone terrace walls can be built to reinforce the bunds on very steep slopes to allow surplus water to pass between the stones without damaging the terrace Macadamia trees can then be planted in the trenches. Excess water can be drained from the trenches using cut-off drains.
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau, F.M. Wandera
Partner organizations	County Government extension service.

<b>2.6.6 TIMP name</b>	<b>Retention ditches</b>
Category (i.e. technology, innovation or management practice)	<p style="text-align: center;"><b>Management Practice</b></p>  <p style="text-align: center;">Retention Ditches</p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off
What is it? (TIMP description)	The impacts of climate change such prolonged heavy rainfall seasons threatens agricultural production, food security and livelihoods especially in high altitude ecosystems. Contour drainage ditches technology has the potential to conserve soil, harvests and store rain water crop use. This technology contributes to restoration and management of degraded lands, reducing soil erosion, vegetation and biodiversity loss as well as crop yields
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliable crop yields.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	<p>Approaches to be used in the dissemination include:</p> <ul style="list-style-type: none"> <li>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the technology is labour intensive.</li> <li>• Farmers and extension service with skills to design and construct stone lines.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor.</li> <li>• External service providers – capacity building and access to</li> </ul>

	technology
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	West Pokot and other counties with suitable agro-ecological conditions for water melon production
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if retention ditches are improperly laid out</li> <li>• Labour intensive and many farmers may find it difficult to implement at large scale</li> <li>• Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate tools for digging out retention ditches for efficiency and increased output per man hour.</li> <li>• Training youthful farmers to be champions of digging out retention ditches.</li> <li>• Training on site specific designs and layout</li> <li>• Fast-track land registration</li> </ul>
Lessons learned, if any	When the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Enforce policies on soil and water conservation at the County level</li> <li>• Create awareness on the importance of soil and water conservation</li> <li>• Avail low cost technologies for soil and water conservation</li> <li>• Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for digging retention ditches. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened</li> <li>• Women and youth have limited access to land for macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as seeds than men.</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for youth during implementation</li> <li>• The technology is acceptable and easy to upscale by both males and female gender</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for macadamia cultivation than men</li> </ul>


	<ul style="list-style-type: none"> <li>• VMGs may also have limited access to finances to buy the required inputs such as seeds than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in various areas as for instance in the provision of finances to VMGs</li> <li>• Increased production will lead to increased consumption and utilization of Macadamias and hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	Over 50,000 smallholder farmers in Eastern and Central Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of retention trenches in hillside to trap runaway water and soil.
Application guidelines for users	The ditches are dug to about 30-60 cm depth and 0.5-1 m width across the direction of the slope. In very stable soils it is possible to make the sides nearly vertical, but in most cases the top width of the ditch needs to be wider than the bottom width. The soil is thrown to the lower side of the slope to prevent it falling back in and form an embankment. On flat land, ditches are spaced at about 20m and have closed ends so that all rainwater is trapped. On sloping land ditches are spaced at 10 - 15 m intervals and may have open ends to discharge excess water.
<b>F: Status of TIMP readiness</b> Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba, F. M. Wandera
Partner organizations	County Governments extension service.

<b>2.6.7 TIMP name</b>	<b>Grass strips</b>
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Category (i.e. technology, innovation or management practice)	<div style="text-align: center;">  <p>Management Practice</p> <p>Grass strips</p> </div>
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off
What is it? (TIMP description)	Grass strips are dense strips of grass planted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively 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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	<p>Approaches to be used in the dissemination include:</p> <ul style="list-style-type: none"> <li>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the County extension service providers.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour</li> <li>• Availability of land, apart from cropland.</li> <li>• Farmers and extension service with skills to design and construct stone lines.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor.</li> <li>• External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Current extent of reach	Practiced widely in many counties, especially where crop-livestock interactions is key
Counties where TIMP will be promoted	Meru and other counties with suitable agro-ecological conditions for water melon production

Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Labour intensive for maintaining and controlling grass from becoming a weed</li> <li>• Reduced land area for crop production</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate tools and suitable grass varieties.</li> <li>• Capacity building on the maintenance of grass strips.</li> <li>• Training on site specific designs and layout</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>• Establishment of grass strips induces a process of natural terracing on slopes as soil collects behind the grass barrier, even in the first year.</li> <li>• Grass strips can be very appropriate for farmers who cut and carry fodder for their animals.</li> <li>• Grasses are also used as mulch for crops by farmers.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Enforce policies on soil and water conservation at the County level</li> <li>• Create awareness on the importance of soil and water conservation</li> <li>• Avail low-cost technologies for soil and water conservation</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for establishing grass strips. The cost will depend on the type of grass to be planted, land size and the landscape terrain/slope
Estimated returns	The returns depend on the value chain being addressed and also type of grass
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology is labour intensive therefore may increase women labour burden</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Women and youth have limited access to productive resources such as land, quality seed potato cuttings and credit</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Potential to create employment for youth through provision of the labour required</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth exists in provision of labour</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories, if any	
Application guidelines for users	Spacing between grass strips depends on the slope of the land. It can be 20-30 m on gentle slopes and 10-15m on steep land. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. The grass needs to be trimmed regularly, to prevent shading and spreading to crop areas. Various grass species are used, e.g., Vetiver, Napier, Guinea and Guatemala depending on what is locally available. Vetiver grass is drought resistant and good for reducing erosion.
<b>F: Status of TIMP readiness</b> (Ready for upscaling, Requires validation; Requires further research)	1 Ready for upscaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau, F. M. Wandera and A.O. Esilaba.
Partner organizations	County Government extension service.

<b>2.6.9 TIMP name</b>	<b>Rain water harvesting systems (ponds and dams)</b>
Category (i.e. technology, innovation or management practice)	<p style="text-align: center;"><b>Management practice</b></p>  <p style="text-align: center;"><b>Water Harvesting pond</b></p>
<b>A: Description of the technology, innovation or management practice</b>	
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	<p>Water, especially with increased incidences of rainfall variability due to climate change, 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</p> <p>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.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, pastoralists and agro-pastoralist
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Demonstrations on technology use;</li> <li>• Farmer Field Schools;</li> <li>• Technical training and re-tooling of extension personnel;</li> <li>• Awareness creation through various platforms like local FM stations</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Avail resources (human, technical and financial) to support acquisition and establishment of water harvesting systems</li> <li>• Policy to support use of communal land to establish and manage the earth dams</li> <li>• Policies supporting Public-Private Partnerships in water harvesting</li> <li>• Sensitization of local communities to embrace the practice</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Private sector – access to technology, access to credit, technology installation</li> <li>• County government – capacity building, policy support, credit facilities,</li> <li>• NGOs – access to technologies, capacity building, technology installation</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Most counties are investing on water harvesting technology at community level. More is required to increase uptake by farmers in ASALs.
Counties where TIMP will be up scaled	Meru and other counties with suitable agro-ecological conditions for water melon production


Challenges in dissemination	<ul style="list-style-type: none"> <li>• High and other counties with suitable agro-ecological conditions for water melon production costs related to technology access and management</li> <li>• Resource use conflicts where land is communally owned</li> <li>• Limited skills in technology installation and management</li> <li>• Limited community mobilization policy for water related activities</li> <li>• Lack of suitable training programs in rainwater harvesting</li> <li>• Lack of proper water usage and control measures</li> <li>• In the case of earth dams where there is a lot of siltation, regular de-siltation is required.</li> <li>• Threats to sustainability of established systems because of lack of community participation in systems monitoring and maintenance.</li> <li>• Vandalism</li> <li>• Some systems require high investment costs.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Resource mobilization through partnerships with private sector</li> <li>• Engaging a participatory process during the planning and implementation of the project.</li> <li>• User specific training programs water harvesting technologies, maintenance and operation skills</li> <li>• Cost of buying water harvesting structures is very high for most households and needs to be reviewed.</li> <li>• Securing systems to prevent vandalism</li> </ul>
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> <li>• Potential to caution community against water scarcity</li> <li>• Improved productivity where water harvesting has been implemented.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Devise systems that are gender sensitive – target different gender needs</li> <li>• Carry out environment and social impact assessment of the technology in specific Counties and cultures</li> <li>• Support structures that help access to credit for technology access and maintenance</li> <li>• Enact Policy frameworks to support water harvesting</li> <li>• Enact policies on land tenure systems to support water harvesting</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Not determined</li> <li>• Not affordable to most rural households.</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Time saved fetching water from afar is channeled into other economic enhancing activities.</li> <li>• Money used to treat diseases related to poor water hygiene is used for other activities.</li> </ul>

	<ul style="list-style-type: none"> <li>• Healthy population will have energy to provide labour required in agricultural activities</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology is labour intensive therefore may increase women labour burden</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Women and youth have limited access to productive resources such as land, quality seed potato cuttings and credit</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Potential to create employment for youth through provision of the labour required</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• The technology is labour intense and may be difficult for the VMG to implement in the field.</li> <li>• The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up</li> <li>• The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth exists in provision of labour</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods</p> <p>A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres.</p> <p>This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater</p>

	harvesting contributes to water conservation thus reducing overexploitation of water resources.
Application guidelines for users	<ul style="list-style-type: none"> <li>• Handbook on Rainwater Harvesting and Storage Options</li> <li>• Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen</li> </ul>
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPP

## GAPS

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

<b>2.6.10. TIMP name</b>	Conservation Agriculture (CA)
Category (i.e. technology, innovation or management practice)	Management Practice  <p style="text-align: center;"><i>Macadamia-coffee intercrop</i></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed:	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)	Conservation agriculture is management practice which maximizes on saving water on the farming by adhering to specific principles that govern it. The practices that make up this approach follow key principles that target to conserve 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	<p>Land productivity is decreasing leading to decreased yield. Continuous land operation continues to emit more GHGs (Carbon) responsible for the climatic changes. Conservation agriculture (CA) has potential to:</p> <ul style="list-style-type: none"> <li>• Enhance management of soil fertility and organic matter, and improvement of the efficiency of nutrient inputs, helping to produce more with proportionally less fertilizer.</li> <li>• 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</li> <li>• 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 bio pores through soil biota and roots</li> <li>• 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</li> <li>• Helps to reduce soil compaction and plough pans and regenerates degraded lands</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension Agents, Researchers
Approaches to be used in dissemination	Agricultural shows, Mass media, Chief's Baraza, Exhibitions, Farmer field Schools (FFS), On-farm and on-station demonstrations, Field Days, Extension Officers
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Training on principles and benefits of CA</li> <li>• Model demonstration using crops</li> </ul>
Partners/stakeholders for scaling up, their roles and stage of involvement	<ul style="list-style-type: none"> <li>• County Extension officers - Dissemination of information, capacity building</li> <li>• NGO's (African Conservation Network, One Acre Fund)- Capacity Building, Dissemination of information</li> <li>• CIAT, FAO – capacity building</li> <li>• County Governments - Funding CA activities, support capacity building, enabling environment and supportive policies</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega
Counties where TIMP will be up-scaled	Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Non-availability of crop residue in suitable quantities</li> </ul>


	<ul style="list-style-type: none"> <li>• Competition for crop residues with other uses like wood fuel and livestock</li> <li>• Land tenure (farmers reluctant to invest in CA where they do not have clear land rights)</li> <li>• Limited knowledge on the incremental benefits of CA</li> <li>• Limited access to CA implements</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Enhance Public Private Partnerships (PPP) to support increased production and market access</li> <li>• Improve KALRO and County government capacity to train and re-tool technical team so as to enhance uptake of the technology</li> <li>• Allocation of more funds for continued research and dissemination of this technology would aid increased uptake of CA with agroforestry</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Uptake of CA technology increases with the realized incremental benefits over time</li> <li>• Continuous capacity building increases CA technology uptake</li> </ul>
Social, environmental, policy and market conditions necessary for development and dissemination	<ul style="list-style-type: none"> <li>• Develop Integrated Herbicide Management Plan – pre-emergence and post-emergence herbicides</li> <li>• Reliable technology adoption and suitable price and market access for produce under CA</li> <li>• Continuous capacity building of the community on the benefits of CA technology</li> <li>• County policies that support households investing in CA with inputs like implements</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Costs related to ripping services and herbicides amount to KES 5000/acre. This is apart from the normal inputs of seed and fertilizer when establishing. But the costs of reduce over the years, while the returns increase
Estimated returns	<ul style="list-style-type: none"> <li>• Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation</li> <li>• Returns on conserving soil exceeding 150 ton/hectare annually and associated increased productivity</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• The technology will reduce women’s time burden of walking far distances in search for water</li> <li>• The technology requires heavy capital investment that may be out of reach for women</li> <li>• Women have less access to land for dam construction</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Potential for youth employment during implementation of the technology</li> </ul>

	<ul style="list-style-type: none"> <li>Water harvesting facilities save the time spent for fetching water especially by women. The saved time will be channeled into other economic activities</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up</li> <li>VMGs have limited access to land for dam construction</li> <li>VMGs have less access to agricultural information, technology and knowledge than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>The technology will reduce the time burden of fetching water by the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	<b>References</b> <ul style="list-style-type: none"> <li>Okoba, B. (2018), Climate-Smart Agriculture: Training Manual for Agricultural Extension Agents in Kenya.</li> <li>Esilaba, E.O (2019), KCEP-CRAL CSA Extension Manual</li> <li>SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Conservation Agriculture. Sustainable Agriculture Information Initiative, Nairobi</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, E. Mutuma
Partner organizations	County government, Private Public Partnerships

### GAPS

1. Identification of the most suitable diversified crop rotations and suitable crops for biomass for the different counties.
2. Development of suitable CA implements/field equipment prototypes.
3. Capacity building on the benefits and operationalization of Conservation Agriculture systems – both among extension and technical staff, and at decision-making levels:

<b>2.6.11 TIMP name</b>	<b>Macadamia and Agroforestry</b>
Category (i.e. technology, innovation or	<i>Management Practice</i>

management practice)	 <p style="text-align: center;"><i>Macadamia-Coffee agroforestry system</i></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed:	<ul style="list-style-type: none"> <li>• Decreased yields, hence low farm returns</li> <li>• Declining soil fertility, hence soil degradation</li> <li>• Soil erosion problems - runoff are minimized</li> <li>• Weeds infestation – manage using increased soil cover</li> </ul>
What is it? (TIMP description)	<p>Agroforestry is a land use management system in which trees or shrubs are grown around or among crops or pasturelands. The most common goal of agroforestry is to develop a symbiotic relationship to achieving agronomic gain on a given piece of land by making use of resources or ecological processes present. The practice is more efficient in nutrient cycling, reduces surface run-off, minimizes leaching of nutrients and protects the ecological system by minimizing the adverse effects of climate change.</p>
Justification	<p>Climate change is negatively impacting agricultural productions. Farmers are experiencing low yields, crop failures, declined soil fertility and generally low farm returns from their investments. Agroforestry is one of the potential management practice of enhancing climate change adaptation. It offers the potential to increase yield, enhance soil fertility/biodiversity increase nutrient cycling and availability and minimize the effects of climate change. The practice is known to build healthy soils, control pests and harness a variety of benefits to increase yields. Agroforestry has a lot in common with intercropping, with both practices emphasizing interaction between different plant species. The compatibility of plants encourages <u>biodiversity</u> by providing a habitat for a variety of <u>insects</u> and <u>soil organisms</u>. The practice has many benefits including reduced of run off and soil erosion losses, improve soil organic matter and nutrient content of soils, maintain favourable soil physical properties, increased nutrient cycling, utilize solar energy more efficiently, leads to reduced insect pests and associated plant diseases, nitrogen fixing agroforestry species substantially increase nitrogen inputs and soil fertility.</p> <p><b>Agrisilviculture:</b> It is defined as growing of trees and agriculture crops together in same lands at the same time</p> <p><b>Silvipastoral system:</b> This system can be defined as growing of trees and grasses or forage species together in same lands at the same time.</p> <p><b>Agrisilvipastoral system:</b> Growing of trees, agriculture crops and grasses together in same lands at the same time is known as agrisilvipastoral system</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

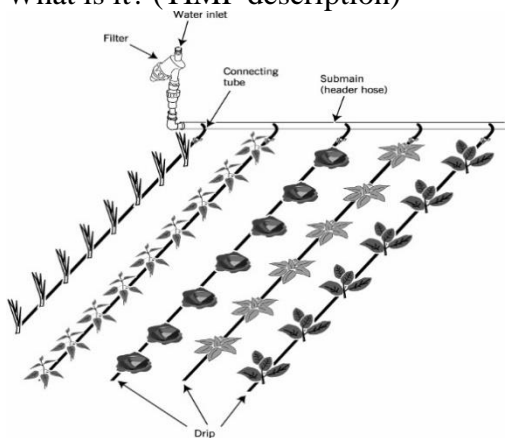
Users of TIMP	Farmers and wide range of users
Approaches to be used in dissemination	Demonstrations, Agricultural shows and Extension services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Awareness creation on the benefits and contribution of the practice to all stakeholders.</li> <li>• Easy access of legume varieties that are compatible with potatoes</li> <li>• Technical packages describing appropriate schedules of planting intercrop.</li> <li>• Package on fertilizer rates and regimes under the practice.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County governments – to provide extension services, farmer mobilization and policy formulation</li> <li>• NGOs – to provide support on capacity building and micro-financing services</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Most counties in the medium to high rainfall areas & arid and semi-arid areas
Counties where TIMP will be up scaled	Meru and any other county with suitable agro-ecological conditions for water melon production
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited access and wide distribution of clean planting materials (intercrop varieties)</li> <li>• Inadequate access of technical materials on the establishment, operations and management of intercrop management practice by farmers</li> <li>• The increased effects of climate change hindering adoption.</li> <li>• Farmer high poverty levels coupled with illiteracy especially in deep rural areas of Kenya.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Enhance access of clean planting materials across the counties. Work closely with certified seed merchants, research institutions</li> <li>• Train and sensitize farmers on the basic principles of intercropping, their benefits and types suitable to their contexts. Use farmer field schools and demonstrations</li> <li>• Develop a comprehensive manual on the practice to guide the farmers during the adoption</li> </ul>
Lessons learned in up-scaling, if any	<p>The practice is very important in pest management. Farmers can use a trap crop to attract pests, keeping them away from the main crop. Therefore, farmers can easily adopt this method to significantly cut down on pesticides input costs</p> <p>The number of ecological benefits provided by this practice can also accelerate upscaling. Agroforestry promotes interactions between crops and pollinators, thus supporting biodiversity and wildlife species.</p>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Socially accepted by both male and female gender.</li> <li>• The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	

Basic costs	This is a low cost management practice though technically demanding especially where the objective is to control pest through agroforestry
Estimated returns	Dependent on the value chain crop
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology may reduce women work burden when it comes to weeding</li> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may have less access to credit for dam construction than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the various gender categories to practice Small Medium Enterprises (SMEs) e.g. tree nurseries.</li> <li>• The technology therefore renders itself to easy adoption by women and youth</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for macadamia cultivation than men</li> <li>• VMGs may have less access to credit</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Reduces labor the VMGs work burden when it comes to weeding</li> <li>• Increased production will lead to increased consumption and utilization of macadamias hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
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 and diversity of agricultural enterprise including bee keeping, tree nursery seedling business and medicinal trees propagation under agroforestry system.
Application guidelines for users	<ul style="list-style-type: none"> <li>• Agroforestry systems aim at improving the overall economics of the farm. It is for this reason any agroforestry idea should first be tested on a relatively small area for evaluations</li> <li>• Observe careful timing of field operations (sometimes necessitating special interventions) to keep competition between the crops and tree species in balance</li> <li>• A mixture of crops with different growth forms or timing of development may make cultivation and use of mulches more difficult and less effective</li> <li>• Planting crops in alternate rows or strips greatly simplifies management and captures some of the benefits of agroforestry in pest control</li> </ul>
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Director

	Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, P. Ketiem, E. Mutuma, M. Okoti, , D. Kamau, A.O. Esilaba
Partner organizations	County governments, ICRAF, KEFRI, KFS

## GAPS

1. Little information on the interactions of various crops and agroforestry tree species especially in the humid and sub humid.
2. Limited knowledge on resource-use efficiency particularly in regions prone to soil erosion
3. Research on mulching using factory/industrial wastes, e.g. mushroom, tea, coffee, etc. in different value chains is required.

<b>2.6 13 TIMP name</b>	<b>Drip irrigation systems for small scale farmers</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>• Increased crop water stress caused by seasonal rainfall variability in rain fed production.</li> </ul>
<p>What is it? (TIMP description)</p>  <p>Layout of a drip irrigation system in vegetables</p>	<p>The technology that supplements water in crop production systems. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points (drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water</p>
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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Model Farmers
Approaches used in dissemination	Field Demonstrations, farmer field schools, ASK trade and exhibition fairs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Correct field design (system installation) of the drip system to minimize water inefficiencies. Training of farmers and extension</li> <li>• Drip management skills</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• County governments; capacity building,</li> </ul>

and their roles	<p>supportive policies and frameworks</p> <ul style="list-style-type: none"> <li>• Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit</li> <li>• NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology demonstration</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Bomet, Kajiado, Machakos
Counties where TIMP will be promoted	Marsabit
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Relatively high cost of drip kits for majority of poor resource farmers in ASALs.</li> <li>• High temperatures experienced in ASALs cause water salinity challenges</li> <li>• Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube</li> <li>• Limited knowledge on the drip irrigation technology and its management</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Model farmer demonstration would create awareness and willingness to invest on the system</li> <li>• Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water</li> <li>• Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters</li> <li>• Intensive farmer training is required on the management of drip irrigation system</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Drip system increases yield, incomes and food security</li> <li>• Linking farmers with markets is critical for enhancing sustainability</li> <li>• Covering the soil with organic matter (crop residue or green manures) in a drip system have also helped preserve moisture and additional nutrients to the soil</li> <li>• It is also important to link farmers to Micro Finance Institutions for financial needs</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Capacity building for increased awareness</li> <li>• Policy support for increased investments in Drip irrigation systems</li> <li>• The water quality should be known to adjust the drip systems to avoid clogging</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Inputs materials include water source, drip lines, drippers, pumping unit, filtering and fertilizing systems. ¼ acre costs between KES 50, 000 to KES



	100,000
Estimated returns	<ul style="list-style-type: none"> <li>• Income from drip system rises by as much as 35% stemming from the management of crop water stresses.</li> <li>• Increased water saving means more water are available for other competing needs (domestic, livestock or industrial).</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Drip systems are easily installed and therefore suitable for both male and female gender</li> <li>• Drip system tend to reduce workload for all gender and provides significant positive impact on family food and nutritional intake.</li> <li>• Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems. This may increase their labor hours</li> <li>• Acceptable and easy to scale up by both male and female, including youth</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities available for women and men to generate sustainable income</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology fits well with the VMGs and easily installed and manageable, thus improving nutrition for the VMG</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as tomatoes and vegetables</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>• There are many successful farmer drip irrigation models across the country implemented by government and other development partners. It is noted that linking markets to crops under drip is crucial for sustainability.</li> </ul>
Application guidelines for users	<p><b>References</b></p> <ol style="list-style-type: none"> <li>1. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA's Regional Land Management Unit, Nairobi.</li> <li>2. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). <a href="http://www.fao.org/3/a-i3765e.pdf">http://www.fao.org/3/a-i3765e.pdf</a></li> </ol>
<b>F: Status of TIMP readiness</b> (1. Ready for Upscaling; 2. Requires validation; 3. Requires further	1 =Ready for up-scaling

research)	
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; Isaya Sijali
Partner organizations	AMIRAN Kenya, HortiPro, 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 under study
2. Limited irrigation packages suited to small farmers - improved irrigation, agronomy, credit, technical support and assistance with marketing – to spur adoption

## 2.7 Macadamia Crop Health


<b>2.1.1 TIMP Name</b>	<p style="text-align: center;"><b>Integrated Management of Macadamia Stinkbug</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center;"><i>a- Mature Macadamaia stink bug</i> <i>b- Kernels damaged by Macadamia Stink bug</i></p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield loss due to pest infestation
What is it? (TIMP description)	Integrating management practices for Macadamia stinkbug by use of biopesticides, IPM compatible pesticides and biocontrol agents to enhance pest population reduction
Justification	Macadamia stinkbug is a major pest of macadamia that can cause yield loss of upto 55% and occasionally higher. Damage is caused by developmental stages from 2 <sup>nd</sup> instar larvae to adult. Damage is highest at altitudes of 1450m to 1550m ASL. Damaged nuts have a brown colour instead of the milky white colour of healthy nuts. A combination of biological control

	agents such as parasitoids and compatible chemical agents can reduce the stinkbug population by between 70% & 90% or more.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public & Private), Processors, Research organisations and CGIARs
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Extension publications</li> <li>• On-farm demonstrations</li> <li>• Farmer field schools</li> <li>• Farmer training</li> <li>• Agricultural shows</li> <li>• Training youth groups to rear and distribute parasitoids within their counties</li> </ul>
Critical/essential factors for successful promotion	Strong partnerships between the service providers and consumers namely researchers, extension agents, processors farmers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Extension service providers (Public and private) to help in the dissemination of various IPM components.</li> <li>• Others are CGIAR's, NGOs through on-farm demonstrations; capacity building of farmers and extension agents in County governments and private sector</li> <li>• Youth groups for rearing and distribution of parasitoids</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<ul style="list-style-type: none"> <li>• Technology partially promoted in Embu and Kiambu but no data is available</li> </ul>
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>• Initially KCSAP Counties will be targeted but eventually all macadamia producing</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Changing farmers from conventional approaches in pest management to currently advocated methodologies</li> <li>• Interesting youth groups to undertake the new ventures</li> <li>• Capacity building the youth groups</li> <li>• Establishing infrastructure for rearing and release of parasitoids</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety.</li> <li>• Availing of resources for dissemination</li> <li>• Elucidating the financial returns to youth groups</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Farmers are likely to adopt as long as the advantages and benefits are made clear</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Social benefits in terms of reduction of exposure to pesticides to be emphasized</li> <li>• Environmental issues in terms reducing impact to biodiversity and improving the living environment by reduction of contaminants to be highlighted</li> <li>• Policy on IPM to be supported by necessary legislation</li> <li>• Market to be encouraged to prioritize pesticide free nuts for</li> </ul>

	premium prices
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Cost of establishing a management package and follow-up visits- KES 25,000.00-40,000.00 per Ha</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• KES 623,000.00-1,424,000.00</li> </ul>
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying than men</li> <li>• Women and youth may have less access to labour than men</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers e.g. in spraying with chemicals</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying than men</li> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers especially during spraying</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-	2-requires validation

requires validation; 3-requires further research)	
<b>G. Contacts</b>	
Contacts	The Centre Director, KALRO-PTC P.O. Box 6223, 01000Thika
Lead organizations and scientists	KALRO PTC- Antony Nyaga Dr. Lusike Wasilwa -KALRO Headquarters
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- CGIAR's</li> <li>- NGOs</li> <li>- County governments</li> <li>- Kenya Biologicals Ltd</li> <li>- Koppert Ltd</li> <li>- Macadamia Nut processors</li> <li>- Nutpak</li> </ul>

1. Biology of parasitoids complex of Macadamia stinkbug
2. Impact of pesticides on parasitoid population
3. Efficacy of the various parasitoid species on management of the Macadamia stinkbug

<b>2.1.2 TIMP Name</b>	<p>Integrated management of Macadamia Nutborers</p>  <p style="text-align: center;"><i>Damage by Macadamia Nut Borer</i></p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield loss due to pest infestation
What is it? (TIMP description)	This involves the Integrated management of Macadamia Nutborers through cultural practices, namely; maintainance of storage hygiene, regular field collection and destruction of infested nuts. It also involves the application of IPM compatible dust formulations in storage areas and regular dehusking



Justification	Macadamia Nutborer is serious pest of Macadamia in higher altitude areas where damage ranges between 3-15% depending on altitude. Infestation can also cause cross-infestation with other storage products
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public & Private), Processors, Research organisations and CGIARs
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Extension publications</li> <li>• On-farm demonstrations</li> <li>• Farmer field schools</li> <li>• Farmer training</li> <li>• Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	Strong partnerships between the service providers and consumers namely researchers, extension agents, processors farmers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Extension service providers (Public and private) to help in the dissemination of various IPM components.</li> <li>• Others are CGIAR's, NGOs through on-farm demonstrations; capacity building of farmers and extension agents in County governments and private sector</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<ul style="list-style-type: none"> <li>• Technology partially promoted in Murang'a, Embu, Meru, Machakos, Baringo, Taita-Taveta and Kiambu Counties but no data is available</li> </ul>
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>• Initially NARIGP Counties will be targeted but eventually all macadamia producing</li> </ul>
	<ul style="list-style-type: none"> <li>• Changing farmers from conventional approaches in pest management to currently advocated methodologies</li> <li>• Capacity building service providers especially among youth groups to undertake the new ventures</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety.</li> <li>• Availing of resources for dissemination</li> <li>• Elucidating the financial returns to service providers among youth groups</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers are likely to adopt as long as the advantages and benefits are made clear</li> </ul>
Lessons learned in upscaling	-
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Social benefits in terms of reduction of exposure to pesticides to be emphasize</li> <li>• Policy on IPM to be supported by necessary legislation</li> <li>• Market to be encouraged to prioritize pesticide free nuts for premium prices</li> </ul>



<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Cost of establishing a management package and follow-up visits- KES 12,500.00-18750.00 per hectare</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• KES 623,000.00-1,424000.00</li> </ul>
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying than men</li> <li>• Women and youth may have less access to labour than men</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers e.g. in spraying with chemicals</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying than men</li> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers especially during spraying</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2- requires validation; 3-requires further research)	1-ready for upscaling
<b>G: Contacts</b>	

Contacts	The Centre Director, KALRO-PTC P.O. Box 6223,Thika 01000
Lead organizations and scientists	KALRO PTC- Antony Nyaga KALRO-HRI-Grace Watani KALRO-PTC-Samuel Kiiru KALRO-Kitale-Dr. Masinde Wanyama KALRO-Kabete-Fredrick Wandera KALRO-Njoro-Jennifer Lugwisi Samuel J.N. Muriuki Dr. Lusike Wasilwa -KALRO Headquarters
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- CGIAR's</li> <li>- NGOs</li> <li>- County governments</li> <li>- Macadamia Nut processors</li> <li>- Nutpak</li> <li>- Kenya Biologics Ltd</li> <li>- Koppert Ltd</li> </ul>

### Gaps

Information on natural enemies with potential in the management of Macadamia nutborers

<b>2.1.3 TIMP Name</b>	<p>Integrated management of Giant rat</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Trap 1-Murang'a</p> </div> <div style="text-align: center;">  <p>Rat Burrow</p> </div> </div>
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	 <p>Trap 2-Taita-Taveta</p>  <p>Giant rat deterrent-Embu</p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Yield loss due to pest infestation and
What is it? (TIMP description)	Management of Giant rat through prevention and trapping
Justification	<ul style="list-style-type: none"> <li>• Giant rats are pests of Macadamia nuts with considerable damage</li> <li>• One burrow will hold as much as 10kg of macadamia nuts</li> <li>• As many as 5 burrows have been recorded in an area of about 400m<sup>2</sup></li> <li>• This represents a loss of about 50kg of nuts or approximately 12.5% yield loss</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public & Private), Processors, Research organisations and CGIARs
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Extension publications</li> <li>• On-farm demonstrations</li> <li>• Farmer field schools</li> <li>• Farmer training</li> <li>• Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	Strong partnerships between the service providers and consumers of the technology namely researchers, extension agents, processors farmers


Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Extension service providers (Public and private) to help in the dissemination of various IPM components.</li> <li>• Others are CGIAR's, NGOs through on-farm demonstrations; capacity building of farmers and extension agents in County governments and private sector</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<ul style="list-style-type: none"> <li>• Technology promoted in Murang'a, Embu, ,Taita-Taveta and Kiambu Counties but no data is available</li> </ul>
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>• Initially KCSAP Counties will be targeted but eventually all macadamia producing ones</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Convincing farmers to abandon conventional approaches in pest management to currently advocated methodologies</li> <li>• Capacity building service providers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Training farmers on the advantages of using IPM approaches</li> <li>• Availing of resources for dissemination</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Farmers are likely to adopt as long as the advantages and benefits are explained clearly</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Social benefits in terms of increased earnings to be emphasized</li> <li>• Policy on IPM to be supported by necessary legislation</li> <li>• Informal sector artisans to be involved in trap improvement</li> <li>• Market to be encouraged to offer higher prices for IPM grown macadamia nuts</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 25,000.00
Estimated returns	KES 623,000.00-1,424,000.00
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying than men</li> <li>• Women and youth may have less access to labour than men</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers e.g. in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required</li> </ul>

adoption and scaling up	<p>inputs such as the chemicals used in spraying than men</p> <ul style="list-style-type: none"> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers especially in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2- requires validation; 3-requires further research)	3-Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC P.O. Box 6223,Thika 01000
Lead organizations and scientists	<p>KALRO PTC- Antony Nyaga</p> <p>KALRO-HRI-Grace Watani</p> <p>KALRO-PTC-Samuel Kiiru</p> <p>KALRO-Kitale-Dr. Masinde Wanyama</p> <p>KALRO-Kabete-Fredrick Wandera</p> <p>KALRO-Njoro-Jennifer Lugwisi</p> <p>Samuel J.N. Muriuki</p> <p>Dr. Lusike Wasilwa -KALRO Headquarter</p>
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- CGIAR's</li> <li>- NGOs</li> <li>- County governments</li> <li>- Macadamia Nut processors</li> <li>- Nutpak</li> </ul>

### Gaps

1. Population dynamics and distribution of Giant rats
2. Efficacy of traps and deterrents

### 3. Alternative management approaches





<b>2.1.4 TIMP Name</b>	<p>Integrated management of Thrips</p>  <p>Infested                      Healthy</p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• Stunted growth in nursery seedlings</li> <li>• Occurrence of pencil leaves in nursery seedlings</li> <li>• Multiple branching</li> </ul>
What is it? (TIMP description)	<p>Thrips interfere with normal growth and development of nursery seedlings</p> <ul style="list-style-type: none"> <li>• Management will involve evaluation of IPM friendly biopesticides for efficacy in the control of thrips</li> <li>• Other approaches will include assessment of agronomic practices such as watering regimes and rootstock cultivar evaluation for impact on thrips population</li> <li>• Evaluation of traps for efficacy</li> </ul>
Justification	<p>Thrips are occasionally very serious pests of macadamia seedlings. Infestation results in growth retardation, multiple branching and leaves assuming a pencil shape. Overall infestation interferes with grafting due to short internodes and lack of a leading shoot.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Nursery operators, Farmers, Extension agents (Public & Private), Research organisations and CGIARs
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Extension publications</li> <li>• On-farm demonstrations</li> <li>• Farmer field schools for nurserymen</li> <li>• Nursery operators training</li> <li>• Agricultural shows</li> </ul>
Critical/essential factors for successful promotion	<p>Strong partnerships between the service providers and consumers of the technology namely researchers, extension agents, processors farmers</p>
Partners/stakeholders for	<ul style="list-style-type: none"> <li>• Extension service providers (Public and private) to help in</li> </ul>

scaling up and their roles	<p>the dissemination of various IPM components.</p> <ul style="list-style-type: none"> <li>• Others are CGIAR's, NGOs through on-farm demonstrations; capacity building of farmers and extension agents in County governments and private sector</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<ul style="list-style-type: none"> <li>• Technology promoted in Murang'a, Embu, Taita-Taveta and Kiambu Counties but no data on efficacy is available</li> </ul>
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> <li>• Initially NARIGP Counties will be targeted but eventually all macadamia producing ones</li> </ul>
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Convincing farmers to abandon conventional approaches in pest management to currently advocated methodologies</li> <li>• Capacity building service providers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Training farmers on the advantages of using IPM approaches</li> <li>• Availing of resources for dissemination</li> </ul>
Lessons learned in upscaling	<ul style="list-style-type: none"> <li>• Farmers are likely to adopt as long as the advantages and benefits are explained clearly</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Social benefits in terms of increased earnings to be emphasized</li> <li>• Policy on IPM to be supported by necessary legislation</li> <li>• Informal sector artisans to be involved in traps manufacture</li> <li>• Market to be encouraged to offer higher prices for IPM grown macadamia nuts</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Approximately KES10,000.00-15,000.00 per hectare
Estimated returns	KES 623,000.00-1,424,000.00
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying than men</li> <li>• Women and youth may have less access to labour than men</li> <li>• Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers e.g. in spraying with chemicals</li> </ul>
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required</li> </ul>

adoption and scaling up	<p>inputs such as the chemicals used in spraying than men</p> <ul style="list-style-type: none"> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers especially during spraying</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	3-Requires further research
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC P.O. Box 6223,Thika 01000
Lead organizations and scientists	<p>KALRO PTC- Antony Nyaga</p> <p>KALRO-HRI-Grace Watani</p> <p>KALRO-PTC-Samuel Kiiru</p> <p>KALRO-Kitale-Dr. Masinde Wanyama</p> <p>KALRO-Kabete-Fredrick Wandera</p> <p>KALRO-Njoro-Jennifer Lugwisi</p> <p>Samuel J.N. Muriuki</p> <p>Dr. Lusike Wasilwa -KALRO Headquarter</p>
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- CGIAR's</li> <li>- NGOs</li> <li>- County governments</li> <li>- Macadamia Nut processors</li> <li>- Nutpak</li> </ul>

### Gaps

1. Information on actual losses and periodicity of thrips infestation
2. Efficacy of biopesticides in management
3. Efficacy of traps on thrips management

<p><b>2.1.1 TIMP Name</b></p>	<p align="center"><b>Intergrated Management of Phytophthora Trunk Canker and Root Rot</b></p> <div style="display: flex; justify-content: space-around;">   </div> <p>Macadamia root rot</p> <p>Cracking &amp; Gum exudation</p> <div style="display: flex; justify-content: space-around;">   </div> <p>Defoliation of affected tree</p> <p>Cracking of the stem</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management Practice</p>
<p><b>A: Description of the technology, innovation or management practice</b></p>	
<p>Problem to be addressed</p>	<p>Phytophthora causes about 60% loss in yields due to macadamia decline. It also finally results in decreased tree population. Management of the disease is anticipated to reduce the impact of the disease in macadamia orchards.</p>
<p>What is it? (TIMP description)</p>	<p><b>Cultural control:</b></p> <ul style="list-style-type: none"> <li>• Ensure good drainage.</li> <li>• Remove infected trees and replace with healthy stock</li> </ul> <p><b>Genetic resistance:</b></p> <ul style="list-style-type: none"> <li>• MRG-20 variety has a high level of resistance to the fungus that causes root rotting and trunk canker</li> </ul> <p><b>Certified planting material:</b></p> <ul style="list-style-type: none"> <li>• Use clean planting material from registered nurseries.</li> </ul> <p><b>Chemical control:</b></p> <ul style="list-style-type: none"> <li>• Apply Alliete (Fosetyl-Aluminium) or Ridomil</li> </ul>


	(Metalaxyl) to lower trunks before the rainy season
Justification	Infection causes significant yield reductions. It reduces growth vigour and productivity of macadamia nuts and eventually death of the trees irrespective of age
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Processors</li> <li>• Extension Officers</li> <li>• Research Organizations</li> <li>• Nursery Operators</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On-farm demonstrations</li> <li>• field days</li> <li>• agricultural shows</li> <li>• Trainings</li> <li>• Factsheets</li> <li>• Manuals</li> <li>• extension leaf-lets</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Willingness of stakeholders to participate.</li> <li>• Better cooperation and collaboration between all stakeholders in the sector.</li> <li>• Funding for research to improve macadamia varieties and extension service to train farmers on management practices</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Producers - smallholders and large scale producers</li> <li>• Aggregators - traders and associations (Macadamia Growers Association of Kenya)</li> <li>• Processors (Nut Processors Association of Kenya-NutPAK)</li> <li>• Influencers - AFA, the Nuts and Oil Crops Directorate (NOCD), the Kenya Bureau of Standards and county governments.</li> <li>• Supporting organisations.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Murang'a, Taita Taveta, Machakos, Kiambu, Koibatek, Baringo, Meru
Counties where TIMP will be up scaled	Initially NARIGP counties but eventually all macadamia producing counties.
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Stakeholders' fragmentation- lack of dialogue and transparency among stakeholders.</li> <li>• Low support to the sector from stakeholders.</li> <li>• The existing policy instruments for the sector are sometimes conflicting.</li> <li>• Uneconomically small farms/economic units</li> <li>• Inadequate information to stakeholders.</li> <li>• Willingness of farmers/stakeholders to participate and adopt new farming models.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Proper sensitization of farmers</li> <li>• Increase Farmers' production capacity.</li> </ul>

	<ul style="list-style-type: none"> <li>• Multiply and disseminate high yielding varieties.</li> <li>• Strengthen public-private partnerships.</li> </ul>
Lessons learned in upscaling if any	-
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Adoption of new farming models.</li> <li>• Development of new resistant varieties.</li> <li>• Elimination of independent agents</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 5,000.00-10,000.00
Estimated returns	KES 623,000.00-1,424,000.00
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying than men</li> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers in performing the operation</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	1- Ready for upscaling
<b>G. Contacts</b>	
Contacts	Centre Director, KALRO-PTC, P.O Box 6223, Thika 01000
Lead organizations and scientists	<p>KALRO PTC – Anthony Nyaga  KALRO-HRI – Grace Watani  KALRO-PTC – Samuel Kiiru  KALRO-Kitale – Dr. Masinde Wanyama  KALRO-Kabete – Fredrick Wandira  KALRO-Njoro – Jennifer Lugwisa</p>

	Samuel J.N Muriuki KALRO-HQ – Dr. Lusike Wasilwa
Partner organizations	Extension Service Providers CGIARs NGOs County Governments NUTPAK Kenya Biologics Limited Koppert Limited

**Gaps:**

1. A detailed assessment of the economic impact of the causal agent on macadamia has never been undertaken.
2. There is little known about the relative susceptibilities of the macadamia varieties to the causal agent.
3. Occurrence and distribution of the disease in macadamia growing areas

<b>2.1.2 TIMP Name</b>	Integrated management of Husk Spot Disease 
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Infection results in premature nut drop. Husk spot results in premature nut abscission giving rise to immature and poor quality kernels unsuitable for processing.
What is it? (TIMP description)	<b>Cultural control:</b> Practice good orchard hygiene.
Justification	Chemical control is not recommended in Kenya. Variation in flowering among varieties results in nut production throughout the year hence adoption of effective cultural control practices will result in low disease incidence.


<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Extension Officers</li> <li>• Research Organizations</li> <li>• Nursery operators</li> <li>• Processors</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On-farm demonstrations</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Trainings</li> <li>• Factsheets</li> <li>• Manuals</li> <li>• Extension leaf-lets</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Willingness of stakeholders to participate.</li> <li>• Cooperation and collaboration between all stakeholders in the sector.</li> <li>• Funding for research to improve macadamia varieties and extension service to train farmers on management practices</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Producers - smallholders and large scale producers</li> <li>• Aggregators - traders and associations (Macadamia Growers Association of Kenya)</li> <li>• Processors (Nut Processors Association of Kenya- NutPAK)</li> <li>• Influencers - AFA, the Nuts and Oil Crops Directorate (NOCD), the Kenya Bureau of Standards and county governments.</li> <li>• Supporting organisations eg KALRO, KEPHIS</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Murang'a, Machakos, Taita-Taveta, Baringo, Kiambu
Counties where TIMP will be up scaled	Initially NARIGP Counties but eventually all Macadamia producing ones
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Stakeholders' fragmentation- lack of forum for information exchange among stakeholders.</li> <li>• Low support to the sector from stakeholders.</li> <li>• Weak policy support for macadamia farming in Kenya.</li> <li>• Uneconomically small farms/economic units</li> <li>• Inadequate information to stakeholders i.e farmers.</li> <li>• Willingness of farmers/stakeholders to participate and adopt new farming models.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Proper sensitization of farmers</li> <li>• Increase Farmers' production capacity.</li> <li>• Multiply and disseminate high yielding seedlings.</li> </ul>

	<ul style="list-style-type: none"> <li>• Strengthened public-private partnerships</li> <li>• Capacity building of service providers</li> </ul>
Lessons learned in upscaling	-
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Adoption of new farming models.</li> <li>• Development of resistant varieties.</li> <li>• Elimination of middle men</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 5,000.00-10,000.00
Estimated returns	KES 623,000.00-1,424,000.00
Gender issues and concerns in development dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying than men</li> <li>• Women and youth may have less access to labour than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying than men</li> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021</li> </ul>

<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	1-Ready for upscaling
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO-PTC, P.O Box 6223-01000 Thika
Lead organizations and scientists	KALRO PTC – Anthony Nyaga KALRO-HRI – Grace Watani KALRO-PTC – Samuel Kiiru KALRO-Kitale – Dr. Masinde Wanyama KALRO-Kabete – Fredrick Wandira KALRO-Njoro – Jennifer Lugwisa Samuel J.N Muriuki KALRO-HQ – Dr. Lusike Wasilwa
Partner organizations	Extension Service Providers CGIARs NGOs County Governments NUTPAK Kenya Biologics Limited Koppert Limited

**Gaps:**

1. Little knowledge of the disease is available hence need for more research.

<b>2.1.3 TIMP Name</b>	Control of <b>Botrytis blight (Raceme Blight)</b> 
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	This is a fungal disease of blossoms of macadamia nut that leads to reduced nut-set. Infection can cause severe fruit drop when prolonged periods of moist weather occur during the flowering period.
What is it? (TIMP description)	It is a Cultural control method where appropriate spacing of orchard trees is ensured with regular pruning to allow more sunlight into the trees
Justification	Inadequate knowledge about the disease and its influence on

	<p>nut set.</p> <p>Attempts to control Botrytis blights with fungicides during severe outbreaks have mostly not been successful. Studies on the disease are necessary.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Extension Officers</li> <li>• Research Organizations</li> <li>• seed producers/Nursery operators</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On-farm demonstrations</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Training</li> <li>• Factsheets</li> <li>• Manuals</li> <li>• Extension leaflets</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Willingness of stakeholders to participate.</li> <li>• Better cooperation and collaboration between all stakeholders in the sector.</li> <li>• Applied and adaptive Research to test, validate and release macadamia varieties</li> <li>• Funding for research on disease epidemiology and management</li> <li>• Funding extension service to capacity build farmers and service providers</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Producers - smallholders and large scale producers</li> <li>• Aggregators - traders and associations (Macadamia Growers Association of Kenya)</li> <li>• Processors (Nut Processors Association of Kenya- NutPAK)</li> <li>• Policy - AFA, the Nuts and Oil Crops Directorate (NOCD), the Kenya Bureau of Standards and county governments.</li> <li>• Supporting organisations</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Murang'a, Kiambu, Kirinyaga, Meru, Baringo, Taita-Taveta, Machakos
Counties where TIMP will be up scaled	Initially NARIGP Counties but eventually all macadamia producing Counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Stakeholders' fragmentation- lack of dialogue and transparency among stakeholders.</li> <li>• Low support to the sector from stakeholders.</li> <li>• Weak policy support for macadamia farming in Kenya.</li> <li>• Uneconomically small farms/economic units</li> <li>• Inadequate information to stakeholders' i.e. farmers.</li> <li>• Willingness of farmers/stakeholders to participate and adopt new farming models.</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Proper sensitization of farmers</li> <li>• Increase Farmers' production capacity.</li> <li>• Multiply and disseminate high yielding seedlings.</li> <li>• Strengthened public-private partnerships.</li> </ul>
Lessons learned in upscaling if any	-
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Adoption of new farming models.</li> <li>• Development of resistant varieties.</li> <li>• Elimination of independent agents</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 5,000.00-10,000.00 per hectare
Estimated returns	KES 623,000.00-1,424,000.00 per hectare
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for Macadamia cultivation than men</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as chemicals used in spraying than men</li> <li>• Women and youth may have less access to labour than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth as service providers in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited resources to purchase the required inputs such as the chemicals used in spraying than men</li> <li>• VMGs have less access to information, technology and knowledge than men</li> <li>• VMGs may have less access to labour than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youth and those recovering from drugs as service providers in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• KALRO Research Orchards</li> <li>• Private farms such as Nando farm</li> <li>• Technology adoption among private players and NGOs is increasing</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• KARI/HDP JICA (1995) - Macadamia Cultivation in Kenya</li> <li>• A Collection of Factsheets for Enhanced Performance of Macadamia Value Chain in Kenya, Kasina, M ed. (2021) A Collection of Factsheets for Enhanced Performance of</li> </ul>

	Macadamia Value Chain in Kenya. NSRC Technical Publication 1 January 2021
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	1-Ready for upscaling
<b>G. Contacts</b>	
Contacts	Centre Director, KALRO-PTC, P.O Box 6223-01000 Thika
Lead organizations and scientists	KALRO PTC – Antony Nyaga KALRO-HRI – Grace Watani KALRO-PTC – Samuel Kiiru KALRO-Kitale – Dr. Masinde Wanyama KALRO-Kabete – Fredrick Wandira KALRO-Njoro – Jennifer Lugwisa Samuel J.N Muriuki KALRO-HQ – Dr. Lusike Wasilwa
Partner organizations	Extension Service Providers CGIARs NGOs County Governments NUTPAK Kenya Biologics Limited Koppert Limited

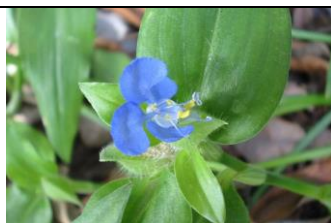
#### Gaps

1. Inadequate knowledge about the disease and its influence on nut set.
2. Accurate assessment of the impact of this disease has not been done.

#### Macadamia Integrated Weed Management

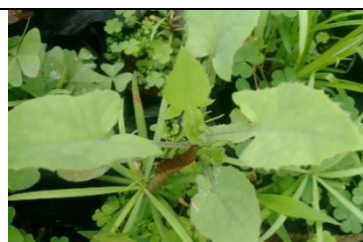
<b>TIMP Name</b>	<b>Macadamia Integrated Weed Management</b>
Crop management practices	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Reduced yield and profitability of macadamia due to competition from different annual and perennial weed species and poor weed management in the cropping systems. Some key weed grass species including Crab sanguinalis ( <i>Digitaria spp.</i> ), goose grass ( <i>Eleusine indica</i> ), Craws feet ( <i>Dactyloctenium aegyptium</i> ), <i>Sateria spp.</i> Palmer amaranths ( <i>Amaranthus palmeri</i> ), Red pigweed ( <i>A. retroflexus</i> ) and Sedges including Yellow nutsedge ( <i>Cyperus esculentus</i> ), and Purple nutsedge ( <i>Cyperus rotundus</i> ) are more a challenge in macadamia growing

fields or regions where they have succeeded because of their morphological and phenological characteristics. Competition occurs at four levels: 1) intraspecific competition between macadamia plants, 2) interspecific competition between macadamia and weed species, 3) interspecific competition between weed species and 4) intra specific competition between same weed species. These weeds steal soil nutrients, moisture, space and sunlight.



Wondering Jew  
(*Commelina benghalensis*)

Double thorn (*Oxygonum sinuatum* and starbur (*A. hispidum*)





Pigweed (*Amaranthus spp.*)

Sow thistle (*Sonchus oleraceae*)



Black Jack (*Bidens pilosa*)

Gallant soldier (*Galinsoga parviflora*)

		
	<p>Figure 1 (<i>Parthenium hysterophorus</i>):</p>	<p>Goat weed (<i>Ageratum conyzoides</i>)</p>
<p>What is it? (TIMP description)</p>	<p>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.</p> <p>Cultural includes transplanting rather than direct planting, proper fertilization, irrigation, use of cover crops and plastic mulch to reduce weed populations. Physical control is the removal of weeds manually or by mechanical means, such as hand weeding or mowing. In manual weeding weeds are removed frequently to ensure area surrounding the tree is weed free as possible. Mow weeds between the rows several times a year to prevent serious competition with young trees. Chemical control is where appropriate recommended herbicides are applied following the label to control weeds. The weed composition needs to be identified and the data used to implement the best management approach timely. Step one is to monitor fields and maintain records of weeds occurring in each field. Identify species and where they are likely to appear. Proper identification of species will guide on management approach. Since one method will be effective only on some species and not others; use two or more approaches as appropriate for a profitable macadamia crop.</p>	



***Weed competition in macadamia seedling stage can be a threat.***

**Justification**


Macadamia are vulnerable to weed invasion especially where growers take weeds for granted. Vine weeds such as cats claw creeper and madeira can quickly spread and smoother even kill large trees. Macadamia are vulnerable to weed invasion, graze and wild fires. Clipping vine weeds such as cat’s clow creeper and madeira vine can quickly spread and smoother even kill large trees. Other weeds such as lantana weeds are a challenge. This is due to limited knowledge on weed biology and management strategies which include physical, biocontrol, intercrops, covercrops and herbicide. Whereas manual weeding can be effective for managing some weed species, it is time consuming and labour intensive. However manual weeding can also be ineffective especially because specific types of weeds such as *Commelina benghalensis* and *Portulaca oleraceae* get apparently disseminated through cuttings and is replanted when weeding is

	done under wet conditions. Hence, regrowth becomes a big problem. 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 macadamia cropping systems.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension workers, Agrodealers
Approaches used in dissemination	Farmer field and business Schools (FFBS), Agricultural Innovation Platforms (AIP), Training workshops, Seminars, Meetings, Demonstrations and field days. Media (Online), manuals, pamphlets.
Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and release IWM in macadamia varieties.</p> <p>A platform for interaction of macadamia value chain stakeholders Promote and train on integrated weed management (IWM).</p> <p>Address environmental and safety concerns related to the use of herbicides.</p> <p>Accompany the promotion with demos and field days with farmers groups and stakeholders on the effectiveness of the various weed management options using FFBS approach.</p> <p>Train stakeholders on biology of weeds and weed dynamics in cropping systems.</p> <p>Farmers need training on timing with regard to conservation of biodiversity. Preserve pollinators for increased productivity of weed control.</p> <p>Train users on appropriate use of herbicide and safe use.</p>
Partners/stakeholders for scaling up and their respective roles.	Agrochemical companies, Agrodealers, KALRO, County extension staffs, CBO, & NGOs).
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	All macadamia growing counties of Kenya
Counties where TIMPs will be up scaled	Meru
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of agronomic practices</li> <li>• Labour intensity of weed control</li> <li>• High cost of herbicides</li> <li>• Inadequate knowledge and information on types of</li> </ul>


	<p>herbicides to use, how and when to use them and their persistence in the soil</p> <ul style="list-style-type: none"> <li>• Myths on appropriateness of using herbicides</li> </ul>
Suggestion for addressing the challenges	<p>Establish macadamia innovation platforms, Promotion of the technology/ product in the suitable areas conducting demos and field days and involvement of the stakeholder e.g. agro-chemical companies and agro-dealers.</p> <p>Develop and disseminate information to various stakeholders.</p> <p>Training on integrated approaches using available methods, including appropriate herbicides for macadamia.</p> <p>Their persistence in different soil environment that can affect follow up intercrop or cover in the first five years of macadamia establishment.</p> <p>Safe use of herbicides.</p>
Lesson learned in upscaling if any	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>That integrated approaches of weed management are more effective than use of one control method and is environmentally friendly.</p> <p>Continuous use of herbicide is an environmental, health and social hazard.</p> <p>Consumers concerns of herbicide residues in the soil and odor absorption by nuts needs attention.</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ IWM</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms.</p>
Social, environmental, policy and market conditions necessary for development and up-scaling	<p>Train stakeholders to understand the working of an integrated weed management program.</p> <p>Address the environmental and social concerns related to use of herbicides.</p> <p>A functional agrodealer network to supply the products when required by the farmers.</p>

	Have a safety plan when using herbicides.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not Costed yet
Estimated returns	Not Costed
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities such as weeding hence this may increase their work burden</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women in weeding and the youths in spraying</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed potato cuttings</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Opportunities exist for those recovering from drugs in weeding and spraying</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities such as weeding hence this may increase their work burden</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories	Kenya small holder farmers.
Application guidelines for users	Scholarspace.manoa.hawaii.edu/bitstream/10125/15280/1/8-121pdf.
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation.
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO , Kabete Dr Hottensiah Mwangi, Dr Momanyi Violet, & Antony Nyaga.
Partner organizations	KALRO- Kabete, KALRO -Thika NGOs, CBOs, County Governments, KEPHIS

<b>TIMP Name</b>	<b>Macadamia Intercropping System</b>
Categories (i.e. technology innovation Or management practice)	Innovation Photo: Macadamia
<b>A: Description of the technology, innovation or management practice</b>	
Problem addresses	 <p><i>Amaranthas spp, grass weeds</i> Source:Hottensiah Mwangi</p> <p>Weed competition is a problem in macadamia cropping system. Suitable crops should be used for intercrop to provide income the years before profitability of nuts. This should be done intelligently to profit trees because of weed control and soil fertility. Farmers inter-cropping</p>


	<p>macadamia with other crops such as corn, papaya, shallow rooted vegetables and passion fruit to reduce weeding and have better returns to their investment in young orchards. Intercropping to control weeds requires specific spacing, the right choice of crops depending on growth habit of the intercrop.</p> <p>This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to macadamia intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition and farmer lack this knowledge.</p>
<p>What is it? (TIMP description)</p>	<p>Innovative Macadamia 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 macadamia.</p> <p>Appropriate crops for intercropping may include planting shallow rooted vegetables (onions, parsley), cereals (maize), legumes (beans), passion fruit and coffee in between rows of macadamia. Innovative intercropping systems will involve arrangement that reduce weeds.</p>
<p>Justification</p>	<p>Intercrops in middle rows done prudently provide weed control between rows and profit macadamias through soil health improvement. Suitable intercrops can provide income during the years before profitability of nuts. 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. Macadamia does well when intercropped with legumes to mitigate the risk of total crop failure due to drought. Intercropping has important advantages in</p>

	<p>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 is one of the most dependable ways to sustain macadamia production in light of prevailing climate change.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	<p>Farmer field and business Schools (FFBS)  Agricultural Innovation Platforms (AIP)  Training workshops, Seminars, Meetings  Promotional materials (posters/ brochures/ leaflets, manuals)  Demos and field days</p>  <p><b>Farmers in an FFBS Session on weed management</b></p>
Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and release intercropping system in maize varieties  A platform for interaction of maize value chain stakeholders  Conduct demos and the field days with farmers groups and stakeholders</p>
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company and seed dealers, Research organizations (KALRO, Egerton University, UoN)
<b>C: Current situation and future scaling up</b>	
Counties where already	Murang'a

promoted if any	
Counties where TIMPs will be up scaled	Meru
Challenges in development and dissemination	Lack of macadamia 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 macadamia innovation platforms Facilitation of training of county extension staffs Contact demos 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 to benefit. Creation of awareness through demonstrations and farmer field days help in adoption of the innovation macadamia intercropping Availability of market is essential Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the innovative intercropping systems.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not costed
Estimated returns	Not Costed
Gender issues and concerns in development, dissemination	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women and youth have limited access to the</li> </ul>

adoption and scaling up	<p>equipment used to make the water pan than men</p> <ul style="list-style-type: none"> <li>• Women have less access to land that can be used for water pan than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Intercropping offers good opportunities to both men and women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• 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</li> <li>• System diversification and yield stability will increase food availability leading to food and nutrition security for the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
Application guidelines for users	
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	2. Require validation
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi

Lead organization and scientists	KALRO Kabete, Dr Hottensiah Mwangi, Dr Violet Momanyi and Antony Nyaga.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs


<b>TIMP Name</b>	<b>Cover cropping for Macadamia weed management</b>
Categories (i.e. technology innovation Or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addresses	<p>Different annual grass weeds and perennial weed species and poor weed management lead to yield losses and lack of profitability in macadamia cropping systems especially at nursery management. Some key weed grass species including Crab sanguinalis (<i>Digitaria spp.</i>), goose grass (<i>Eleusine indica</i>), Crawsfoot (<i>Dactyloctenium aegyptium</i>), <i>Sateria spp.</i>, double thorn ( <i>Oxygonum sinuatum</i>) Palmer amaranths (<i>Amaranthus palmeri</i>), Red pigweed (<i>A. retroflexus</i>) and Sedges including Yellow nutsedge (<i>Cyperus esculentus</i>), and Purple nutsedge (<i>Cyperus rotundus</i>) are more a challenge in macadamia growing fields or regions where they have succeeded because of their morphological and phonological characteristics.</p>  <p><i>Figure 2 Weeds Grasses and broadleaved associating</i></p>
What is it? (TIMP description)	This is a technology where specific selected crops are grown to produce biomass/canopy to cover soil. This may

	<p>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 and stop emerging weeds. Large amounts of cover crop biomass suppress weeds in a subsequent season and duration of effective suppression depends on type of cover crop used and amounts of biomass used.</p>
Justification	<p>Cover cropping with appropriate variety of cover crop (technology) works well with macadamia in no till system. Cover crop like rye and wheat is planted in fall to develop cover. 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 including black oats may produce allelochemicals 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 could be good cover crops particularly legumes and cereals.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	<p>Farmer field and business Schools (FFBS)  Agricultural Innovation Platforms (AIP)  Creation of awareness through demonstrations and farmer field days help in adoption of the varieties  Availability of market  Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms  Demos and field days</p>

Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and release cover cropping in macadamia varieties</p> <p>A platform for interaction of macadamia value chain stakeholders</p> <p>Conduct demos and the field days with farmers groups and stakeholders</p>
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company and seed dealers, Research organizations (KALRO, County staff).
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Murang'a
Counties where TIMPs will be up scaled	Meru
Challenges in development and dissemination	<p>Lack of macdamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</p> <p>Low use of the agronomic practice</p> <p>Labour intensity in planting and weeding</p> <p>Inadequate training and limited extension staff</p>
Suggestion for addressing the challenges	<p>Establish macadamia innovation platforms</p> <p>Information dissemination on the technology</p> <p>Promotion of the technology in the suitable areas</p> <p>Facilitation of training of county extension staffs</p> <p>Contact demos and field days</p>
Lesson learned in upscaling if any	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technology.</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>Cover crop technology is knowledge intensive. Such a</p>

	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.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	-Depends on crop variety used and method used to manage it.
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Cover cropping system can result in reduced labour, for women who mostly perform the task of weeding</li> <li>• Women and youths have less access to technology knowledge and information</li> <li>• Women have less access to farm implements</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women to perform the operation</li> <li>• Diversity and yield stability are a major win for the various gender categories</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Cover cropping system can result in reduced labour for the VMGs</li> <li>• VMGs may have less access to specialized implements required for cover cropping systems</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Cover cropping system can result in reduced labour for the VMGs</li> <li>• System diversification and yield stability will increase food availability leading to food and nutrition security for the VMGs</li> <li>• Improved income from production and marketing of macadamia and other cover crops</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Most macadamia growing areas
Application guidelines for users	<b>Mwangi, H.W.</b> , Kihurani, A.W., Wesonga, J.M., Ariga, E.S. & Kanampiu, F. (2015a). Factors influencing

	adoption of cover crops for weed management in Machakos and Makueni counties of Kenya. <i>European Journal of Agronomy</i> 69(2015)1-9. <a href="http://dx.doi.org/10.1016/j.eja.2015.05.001">Http://dx.doi.org/10.1016/j.eja.2015.05.001</a> .
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	2. Require validation
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO Kabete, Dr Hottensiah Mwangi, Dr Violet Momanyi , Antony Nyaga.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

<b>TIMP name</b>	<b>Mulching</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Weed competition for soil nutrients, moisture and unfavorable soil temperatures. 
	<b>Figure 3 Starbur (<i>Acanthospermum hispidum</i>) and Double thorn (<i>Oxygonum sinuatum</i>) and other annual grasses</b>
What is it? (TIMP description)	The practice of covering the soil/ground with natural

	<p>materials or synthetic materials. Mulches can effectively control weed seedlings emerging and seeds that germinate near or at the soil surface. There are two types of mulches: biodegradable or natural mulches. Biodegradable include straw, dead leaves and compost to make more favourable conditions for macadamia growth, development and efficient production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used in growing of maize.</p> <p>Benefits: Organic mulches suppress weeds; retain moisture in the soil; keep the soil cool; and help improve soil fertility (as the mulches decompose providing calcium, boron, zinc, Nitrogen, Potassium, and trace elements) and improves microclimate hence increasing biodiversity.</p> <p>Synthetic mulches will solarize soils, control weeds and weed seeds, retain soil moisture and controls diseases. Inspect and pull out emerging weeds timely.</p>
Justification	<p>Weeds can easily choke and kill out young seedlings. In Sand box or seed bends use of Black polythene prevents light from reaching the small weeds and prevent germination. Organic mulching (straws or dry leaves) on rows have added benefits other than minimizing weeds infestation. It facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil structure directly by preventing raindrop impact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers


Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Farmer field Business schools</li> <li>• On-farm demonstrations during farmer field days</li> <li>• Training in workshops</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release mulching technology in macadamia varieties</li> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Organic: <ul style="list-style-type: none"> <li>• Availability of plant or crop residues for organic mulches.</li> <li>• Size of the land.</li> <li>• Competing uses of crop residues.</li> <li>• Type of the crop residues</li> <li>• Synthetic</li> <li>• Cost of materials</li> <li>• Disposal of material after use.</li> </ul> </li> </ul>
Partners/stakeholders for scaling up and their roles	<p>County government extension services; Provide link with farmers</p> <p>Community farmer groups; play coordination role for ease in problem identification and dissemination</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	In Kenya.
Current extent of reach	Available and practiced in different commodity value chains
Counties where TIMP will be promoted	Meru.
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the agronomic practice</li> <li>• Labour intensity and availability of mulching</li> </ul>

	<p>materials</p> <ul style="list-style-type: none"> <li>• Lack of enough plant and crop residues due to competing uses of organic mulches.</li> <li>• Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.</li> <li>• Beware of small tears and rips which will allow weeds emergence through plastic mulches including around the holes . Purple and yellow nutsedge may penetrate mulches as early as six days after transplant in plastic mulches.</li> </ul>
<p>Suggestions for addressing the challenges</p>	<ul style="list-style-type: none"> <li>• Establish macadamia innovation platforms</li> <li>• Crop diversification to increase availability of organic mulches.</li> <li>• Establish and follow a good integrated weed management control program for the particulars melon varieties.</li> <li>• Monitor for any tears /rips and pull out any weeds without allowing them to take over.</li> <li>• Adapting alternative mulching materials like high absorbance polymers.</li> </ul>
<p>Lessons learned</p>	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the varieties</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ IWM</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• There is need to adapt to alternative mulching technologies in addition to use of organic materials like straws dry leaves, and dry grass.</li> </ul>
<p>Social, environmental, policy and</p>	<ul style="list-style-type: none"> <li>• Practice is socially acceptable</li> <li>• Environmentally friendly</li> </ul>

market conditions necessary	<ul style="list-style-type: none"> <li>• Increased productivity will provide supply to the markets</li> <li>• Supporting frameworks/policies are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	Dependent varieties of macadamia but generally about 100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• 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</li> <li>• Since the activity is labour intensive it may increase the labour burden for the various gender category especially women who are already overburdened</li> <li>• The TIMP will reduce women's weeding time that can be used performing other productive activities</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• The TIMP can offer employment opportunities for the youths.</li> <li>• Mulching reduces weeds thus women who perform most of the weeding activities will be relieved to perform other equally demanding economic activities</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Though easy to use, it is a bit labour intensive for VMGs, hence its adoption and scaling up may be an uphill task</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally

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

<b>TIMP Name</b>	<b>Herbicide (Chemical) Weed Control</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	

<p>Problem addressed</p>	<p>Competition from weeds prevents macadamia getting nutrients, soil moisture and space resulting to weak and stunted growth leading to reduced final yields. This poses a problem to young macadamia. Amount of damage on young macadamia depends on weed density and diversity, stage of weed growth and environment. The grass weed problems include crab sanguinalis (<i>Digitaria sanguinalis</i>), and goose grass (<i>Eleusine indica</i>). Broadleaved weeds including Palmer amaranths (<i>A. palmer</i>), Red pigweed (<i>A. retroflexus</i>), Purple nutsedge (<i>Cyperus rotundus</i>) and Yellow nutsedge (<i>C. Esculentus</i>) are more challenging. The weed problem is aggravated by wrong timing and poor method of weed control activities.</p>
<p>What is it? (TIMP description)</p>	<p>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 weed species. Herbicide weed control is a technology that requires intensive knowledge on herbicides mode of action, the one selective for macadamia, conditions necessary for effective application, type of soil, when to apply and how to application is done.</p> <p>Use only recommended herbicides listed by Pesticide Control Board as per label.</p>  <p><b>Figure 4 Hand weeded(fore) compared to herbicide sprayed maize plot background) 27-29 May, 2021, Source Hottensiah Mwangi</b></p>

Justification



**Figure 5 Laborious hand weeding**

Manual hand weeding is very labour intensive, labour is scarce and expensive.



**Figure 6 Herbicide application – KALRO, 8-9 April 2021 Source Hottensiah Mwangi**

Appropriate use of herbicides (all applications should be done at the right rate and according to label) reduces drudgery and allows timely weed control. Activated diesel oil emulsion herbicides sprays can reduce cost considerably compared to hand weeding. 2,4-D is used in Macadamia orchards for control of *Commelina*, *P. clandestinum*, *P. purpurescens*, *C. dactylon* and *Dalapon* 10pounds /acre, or two sprays to control grasses. Spray at low pressure, three times at 15 days interval on young succulents weeds.

Post emergence herbicides such as Agromine and Catapult are applied to control blackjack 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 speed or walking speed. Avoid spraying bark or foliage of young macadamia plants.

Do not spray any herbicides on orchards with nuts because nuts absorb odour of herbicides.

Region promoted

Limited use of herbicide among small scale farmers in

	maize.
Counties where TIMP will be upscaled	Herbicide weed control can be upscaled in all the areas where maize is being grown.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of herbicides.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release herbicide weed control in macadamia varieties.</li> <li>• A platform for interaction of macadamia value chain stakeholders</li> <li>• Capacity building and training on safe use of herbicide for all users</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• Chemical companies for back stopping.</li> <li>• FIPs (Farmer Input Promotion) for promotion.</li> <li>• Farmer Groups for activity implementation and promotion.</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like</li> </ul>

	community mobilization, nutrition training etc.
<b>C: Current situation and future scaling up</b>	
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	<p>Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders.</p> <p>Low use of agronomic practice</p> <p>Limited knowledge and information and low literacy levels among the farmers or sprayers to read and interpret label instructions.</p> <p>Capacity building is required to impart knowledge and skills in safe use and application of herbicides.</p> <p>The farmers need to understand the proper use and application of herbicides to avoid buying inappropriate herbicides and minimize health, environmental and social hazards.</p>
Recommendations for addressing the challenges	<p>Establish macadamia innovation platforms</p> <p>There is need to train the advisory and service providers as TOTs on appropriate use of herbicides. This help in reaching the farmers with the information.</p> <p>Herbicides like all chemicals have to be used with care to avoid environmental, health and social hazards.</p> <p>Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on safe use of herbicides.</p>
Lessons learned	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technology-chemical weed control</p> <p>Consumers concerns of herbicide residues in the soil</p>

	<p>and subsequent crops needs attention</p> <p>Availability of Macadamia market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>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.</p>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of herbicides is vital.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Herbicide use is cheaper than manual weed control because it requires less labour and achieves timely weed management.
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Men and youth perform most of the spraying activities hence this may reduce the women work burden</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the youths in spraying</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed potato cuttings</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> </ul>

	<ul style="list-style-type: none"> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Opportunities exist for those recovering from drugs in spraying</li> <li>• Use of herbicides will improve weed management leading to increased productivity, increase availability of macadamia for consumption which will improve food security hence improved</li> </ul>
VMG issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Men and youth perform most of the spraying activities hence this may reduce the women work burden</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the youths in spraying</li> </ul>

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

Success stories	.Large scale farms in Kenya
Application guidelines for users	Herbicides. NORTH CALORINA STATE EXTENSION. < <a href="https://content.ces.ncsu.edu">Https//content.ces.ncsu.edu</a> >
F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	Requires validation and more research
<b>G: Contacts</b>	
Contacts	KALRO,
Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr Violet Momanyi, Antony Nyaga.
Partner organizations	MoALF in Counties, Chemical companies.

<b>TIMP Name</b>	<b>Rapid response to Invasive weed species</b>
Category (i.e. technology, innovation or management)	Innovation

practice)	
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<p><b>Management Practice</b></p>  <p><b><i>Highly invasive weeds such as dodder</i></b></p> <ul style="list-style-type: none"> <li>-High incidence of invasive weed species such as doddars (<i>Cuscuta campestris</i>) [African Lovegrass (<i>Eragrostis curvula</i>)], <i>Solanum incanum</i>.</li> <li>-Ineffective, inefficient and unsustainable methods used to control invasive species</li> <li>-Limited knowledge on invasive weeds species.</li> </ul>
What is it? (TIMP description)	<p>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 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. Non selective, broad spectrum; All herbicides are applied as recommended in the manufacturers label, and all instruction followed.</p> <p>This can be followed by mulching to stop further infestation by weeds.</p> <p>(a) Spot spray application.        Boom application. Low rates of Glyphosate should be added for seedset suppression.</p>

	(b) Non selective, broad spectrum; Are applied as directed or guarded with a hood to avoid harming the crop, mostly used in zero and minimum tillage.
Justification	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): which, focuses on strengthening national systems to better prevent, eradicate, control and manage Invasive Species. Macademia 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>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches used in dissemination	<p>1.0 Awareness\  1.1 Prevent,  (i) Ensure the planting material of the crop plant is clean (not contaminated with the field dodder).  (ii) Removal of highly favored hosts such as field bindweed (<i>Convolvulus arvensis</i>) from around the field edges is recommended.  1.2 Detect,  1.3 Control</p> <p>Physical/Mechanical Control  The young seedlings of the field dodder with its primary roots can be destroyed before they get out of control. This can be done by careful tillage or hand-pulling when infestations are still scattered, in order to avoid removal of the infested crop plant with the field dodder.  1.3.1 surveillance,  1.3.2 Quarantine priority invasive species.</p>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>-Sustained demand for effective weed control methods</li> <li>-Favorable climatic conditions for tomato production</li> <li>-Collaboration between all partners</li> </ul>
Partners/stakeholders for scaling up and their roles	<p>KALRO, will conduct trials and management of parasitic invasive species in hotspots;  County governments and extension farmers'</p>

	groups/CBOs, NGOs, will implement extension.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	All counties growing Macadamia
Counties where TIMP will be upscaled	21 Meru, Muranga, Nyanza Region Counties, Taita Taveta, Embu, Kiambu among others
Challenges in dissemination	-Limited knowledge on weed biology -Limited resource personnel
Suggestions for addressing the challenges	- Create awareness, - 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 upscaling, if any	The current mindset and dependence on manual weeding to produce healthy macadamia needs to be addressed.
Social, environmental, policy and market conditions necessary for development and upscaling.	-Favorable climatic conditions for macadamia production -Sustained market demand for high quality macadamia nuts.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the weeding activities than the other gender categories</li> <li>• Women have less access to information, technology and knowledge</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women employment in mechanical weeding</li> </ul>
VMG issues and concerns in	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> </ul>

development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed potato cuttings</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youths employment in mechanical weeding</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<p>Research work done on IWM in weed control in macadamia, KALRO-Kabete.</p> <p>Invasive spp. work in Michigan <a href="http://misin.msu.edu">misin.msu.edu</a>;; <a href="http://weedsmart.org">weedsmart.org</a>;; <a href="http://Southwest.desert.flora">Southwest.desert.flora</a>;;</p>
Application guidelines for users	Guidelines are needed
<b>F: STATUS OF TIMP READINESS</b> (Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation and upscaling.
<b>F: Contacts</b>	
Contacts	Director, KALRO Kandara; KALRO - Kabete.
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr J. Violet Momanyi. Antony Nyaga.
Partner organizations	MoALF&I, County governments.

<b>TIMP Name</b>	<b>Solarisation Bed for Weed Control</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	

Problem addressed



***Figure 7 Diversity of weed species (grasses, broadleaved, annuals and perennials) that emerge to compete with maize seedling for available nutrients, moisture and space***

Competition from weeds in seed bendscan weak and stunted growth in macadamia seedlings. Weeds poses a problem around young macadamia 40-70 days after emergence during the critical period of weed management. This depends on weed density, diversity, stage of weed growth and environment. The grass weed problems include crab sanguinalis (*Digitria sanguinalis*), Sudan grass (*Sorghum halepense*) and goose grass (*Eleusine indica*) and *Echinocloa colona*. Broadleaved weeds include Palmer amaranths (*A. palmeri*), Red pigweed (*A. retroflexus*) and *C. arvense* L.), (*Chenopodium album* L.), (*Rumex crispus* L.) and *Portulaca oleraceae*. The Purple nutsedge (*Cyperus rotundus*) and Yellow nutsedge (*C. Esculentus*) are more challenging.

What is it? (TIMP description)

Solarisation is a method where you use transparent polythene films and increase soil temperatures by 10<sup>0</sup>C or more than atmospheric to kill weed seeds and seedlings. Basic phenomena is building up of lethally high temperatures in top soil where most dormant and viable seeds are present. The Mechanism is mainly breaking dormancy of weed seeds and solar scotching of emerged weed seedlings and direct killing of weed seeds by heat. The mechanism can


	increases soil temperature by 8-12 °C over non mulched soil. Rhizomes of perennial weeds may be killed if not deeply buried. Effectiveness is species specific and also depends on length of period of heating.
Justification	Solarization for two consecutive years is successful in controlling perennial weeds such as sedges. Solarization with 0.05mm T Polythene sheets 40 days is effective in controlling weeds than use of 0.01mm polythene and takes shorter time duration. This is a good ecological and environmentally friendly method that is sustainable for small scale seedling producers.
Region promoted	Thika-KALRO
Counties where TIMP will be upscaled	Meru
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	Farmer field and business Schools(FFBS) Agricultural Innovation Platforms (AIP) On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on how to use solarization.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release solarisation bed technology weed control in macadamia varieties A platform for interaction of macadamia value chain stakeholders Development of the agronomic practice for macadamia Capacity building and training on use of polythene and solar power.

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I] for extension,</li> <li>• Chemical companies for back stopping.</li> <li>• FIPs (Farmer Input Promotion) for promotion.</li> <li>• Farmer Groups for activity implementation and promotion.</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Validation of these solarization needs to be done before recommendations are given to the farmers.
Challenges in dissemination	<p>Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</p> <p>Low use of the agronomic practice</p> <p>Labour intensity</p> <p>Limited knowledge and information and low literacy levels among the farmers.</p> <p>Capacity building is required to impart knowledge and skills in appropriate use and application of solarization.</p> <p>The farmers need to understand the proper use and application of solarization to avoid buying inappropriate polythene and minimize health, environmental and social hazards.</p>
Recommendations for addressing the challenges	<p>Establish macadamia innovation platforms</p> <p>There is need to train the agricultural extension county officers as TOTs on appropriate use of solarization. This help in reaching the farmers with the information. Polythene disposal should be done carefully to avoid environmental, health and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for farmer</p>

	empowerment and guidance on reuse and polythene disposal.
Lessons learned	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform.</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technology of Solarisation bed for weed control</p> <p>Availability of market for macadamia is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms.</p> <p>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.</p>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of polythene is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Solarization to control weeds 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, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women stand to benefit in increased production due to timely operations, increased yields and sales</li> </ul>

VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land and credit</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Use of this technology will improve weed management leading to increased productivity, increase availability of macadamia for consumption which will improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women stand to benefit in increased production due to timely operations, increased yields and sales</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	.
Application guidelines for users	Scholars <a href="http://space.manoa.hawaii.edu/bitstream/10125/16280/1/8-121pdf">space.manoa.hawaii.edu/bitstream/10125/16280/1/8-121pdf</a>
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	Requires validation and more research
<b>G: Contacts</b>	
Contacts	KALRO,

Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr Violet Momanyi, Antony Nyaga.
Partner organizations	MoALF in Counties, Chemical companies.

TIMP Name	Stale seed bed for Weed Control
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	 <p><b>Figure 8 <i>Datura stramonium</i> among other weeds</b></p> <p>Competition from weeds prevents macadamia getting available resources and can cause weak and stunted growth. This poses a problem around young macadamia just starting. This depends on weed density and diversity, stage of weed growth and environment. The grass weed problems include crab sanguinalis (<i>Digitaria sanguinalis</i>), and goose grass (<i>Eleusine indica</i>). Broadleaved weeds include Palmer amaranths (<i>A. palmer</i>), Red pigweed (<i>A. retroflexus</i>), Datura (<i>Datura stramonium</i>) Purple nutsedge (<i>Cyperus rotundus</i>) and Yellow nutsedge (<i>C. Esculentus</i>) are more challenging. The weed problem is aggravated by wrong timing and poor method of weed control activities.</p>
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 macadamia variety 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 macadamia seedling. Problem is most weed seeds that have the potential to develop are those where there is adequate soil moisture and temperature of 50 <sup>0</sup> F at a depth of 2 inches. Several passes are made in soil with rotoSpike tooth hallow is very useful implement for destroying the emerging weeds during preparation of stale beds. Then weed seeds allowed to germinate as weather permits. Then the weeds are dessicated or plowed.
Justification	With sound knowledge of weed phenology and other factors like temperature, irrigation and humidity at the local level it is possible to predict when certain weeds will raise problems in maize seedbed.
Region promoted	
Counties where TIMP will be upscaled	Stale bed weed control can be upscaled in all the areas where macadamia is to be planted.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Training workshops, Seminars, Meetings On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on how to use stale bed.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release stale seed bed for weed control in macadamia varieties A platform for interaction of macadia value chain stakeholders

	Capacity building and training on use of polythene and stale bed
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• Chemical companies for back stopping.</li> <li>• FIPs (Farmer Input Promotion) for promotion.</li> <li>• Farmer Groups for activity implementation and promotion.</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Validation of these stale beds needs to be done before recommendations are given to the farmers.
Challenges in dissemination	<p>Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</p> <p>Low use of the technology</p> <p>Labour intensity</p> <p>Limited knowledge and information and low literacy levels among the farmers.</p> <p>Capacity building is required to impart knowledge and skills in safe use and application of stale beds.</p> <p>The farmers need to understand the proper use stale beds</p>
Recommendations for addressing the challenges	<p>Establish macadamia innovation platforms</p> <p>There is need to train the agricultural extension county officers as TOTs on appropriate use of stale beds. This help in reaching the farmers with the information. Polythene disposal should be done</p>

	carefully to avoid environmental, health and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on use of stale bed.
Lessons learned	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technology- Stale seed bed</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>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.</p>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of stale beds is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Stale bed use is cheaper than manual weed control because it requires less labour and achieves timely weed management.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women stand to benefit in increased</li> </ul>

	production due to increased yields and sales
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land and credit</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Use of this technology will improve weed management leading to increased productivity. Increase availability of macadamia for consumption which will improve food security hence improved health of VMGs; high value of crop will lead to economic empowerment of VMGs</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Women stand to benefit in increased production due to increased yields and sales</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	.
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	Requires validation and more research
<b>G: Contacts</b>	
Contacts	KALRO,





Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr Violet Momanyi, Dr Antony Nyaga
Partner organizations	MoALF in Counties, Chemical companies.

<b>TIMP Name</b>	<b>Transplanting Macadamia for weed control</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Competition from weeds prevents macadamia getting available resources and can cause weak and stunted growth. This poses a problem around young macadamia just starting. This depends on weed density and diversity, stage of weed growth and environment. The grass weed problems include crab sanguinalis ( <i>Digitaria sanguinalis</i> ), and goose grass ( <i>Eleusine indica</i> ), broadleaved weeds including Palmer amaranths ( <i>A. palmer</i> ), Red pigweed ( <i>A. retroflexus</i> ). Purple nutsedge ( <i>Cyperus rotundus</i> ) and Yellow nutsedge ( <i>C. Esculentus</i> ) are more challenging. The weed problem is aggravated by wrong timing and poor method of weed control activities.
What is it? (TIMP description)	Prepare appropriate soil media. Mix with manure in the ratio 1:1. This is put in environmentally sound bags/Papers. One clean certified macadamia seed variety of desired preference is sowed per polythene bag and kept in a slight shade and watered regularly for about 40-70 days before transplanting. The timing macadamia seed 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 macadamia with manure as recommended in particular field. Immediately it rains remove the macadamia from nursery, each polyhtene paper with on seedlings, cut and plant in the ready prepared holes. Weed regularly depending on location using a preferred suitable method and the macadamia will develop.
Justification	With sound knowledge of macadamia nursery and weed phenology and other factors like temperature, irrigation and humidity at the local level it is possible to predict when certain weeds will raise problems in macadamia nursery and to remove them easily as compared to the field. Transplanted macadamia has less weeding to be done once the weeding method of choice is used. Transplanting has advantage in that when rainfall is delayed macadamia watering intervals are reduced to make the crop resistant stress in the nursery. This is a climate smart technology for


	resilience and food security and to improve lively hoods.
Region promoted	Murang'a.
Counties where TIMP will be upscaled	Meru.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	<b>Farmer field and business Schools (FFBS)</b> <b>Agricultural Innovation Platforms (AIP)</b> Training workshops, Seminars, Meetings On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on how to use maize transplanting.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release transplanting technology. A platform for interaction of maize value chain stakeholders Capacity building and training on use of polythene and transplanting maize.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I] for extension,</li> <li>• Chemical companies for back stopping.</li> <li>• FIPs (Farmer Input Promotion) for promotion.</li> <li>• Farmer Groups for activity implementation and promotion.</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Validation of these stale beds needs to be done before recommendations are given to the farmers.
Challenges in dissemination	Lack of maize 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, maize nursery and transplanting. The farmers need to understand the proper use transplanting technology.

Suggestions for addressing the challenges	<p>Establish maize innovation platforms</p> <p>Promotion of the transplanting technology in the suitable areas</p> <p>There is need to train the agricultural extension county officers as TOTs on appropriate use of transplanting maize. This help in reaching 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 on the ground for farmer empowerment and guidance on use of transplanting technology.</p>
Lessons learned	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of technologies</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>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.</p>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of transplanting technology.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Transplanting maize 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, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• The management practice may not be adopted if the gender targeted is women who are already overburdened</li> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youths in performing the operation</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land and credit</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for and youths and those recovering from drugs in performing the operation</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• The management practice may not be adopted if the gender targeted is women who are already overburdened</li> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youths in performing the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	.Laikipia County, Solio Villages and Siaya.
Application guidelines for users	Upscaling of Soil Management Technologies and Drought tolerant Maize Varieties for increased maize productivity in the East and Central Africa. H.W.Mwangi, F.Mgonja, H. Admassu, F. Opio, I.Rwomshana, J. Karau, and V.Kimani. pg 215-223. 2011. Advances in Research for Development. ASARECA Success stories. 2011. Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	Requires validation and more research.
<b>G: Contacts</b>	
Contacts	KALRO,
Lead organization and scientists	KALRO Dr Hottensiah Mwangi, Dr Violet Momanyi. Dr Antony Nyaga
Partner organizations	MoALF in Counties, Chemical companies.


<b>TIMP Name</b>	<b>Mechanical weeding</b>
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<p>Hand weeding manually is commonly done to remove weeds in the macadamia crop</p>  <p><i>Weeding using panga</i></p>  <p><i>Weeding using a "Muro"</i></p>  <p><i>Weeding using a "jembes"</i></p>
What is it? (TIMP description)	<p>Prepare land well using hand tools to get a weed free seedbed. Sow clean certified seeds into a weed free field. The sowing is done in rows to facilitate inter row weeding.</p> <p>Timely weeding is most effective at 15 days interval.. Avoid weeding delay that may result to weed take over with consequent severe competition with the</p> 

<i>Clean maize seed bed, rows prepared to facilitate inter-row weeding timely when weeds emerge</i>	<p>macadamia. Use appropriate tools for weeding to avoid shock-stress on macadamia due to disturbance and root damage on macadamia roots because they are shallow therefore very sensitive.</p> <p>The weeds near the roots can be removed by hand pulling.</p>
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.
Region promoted	All areas where macadamia are grown.
Counties where TIMP will be upscaled	Meru.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and Agricultural extension officers.
Approaches used in dissemination	<p>Farmer field and business Schools (FFBS)</p> <p>Agricultural Innovation Platforms (AIP)</p> <p>On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.</p>
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and release improved mechanical weeding.</p> <p>A platform for interaction of macadamia value chain stakeholders</p> <p>Participatory Implementation, stakeholder sensitization.</p>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I] for extension,</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing, and Others e.g. NGOs,</li> </ul>


	CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Limited research done on gender responsive weeding implements.
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Labour intensity</li> <li>• Low use of agronomic practices</li> <li>• Labour intensity</li> <li>• Appropriate implements are not readily available in the market such as subsoilers.</li> </ul>  <p><i>Subsoiling using a subsoiler for minimum soil disturbance</i></p>
Suggestions for addressing the challenges	<p>Establish macadamia innovation platforms</p> <p>Work with Jua Kali industries for fabrication of appropriate implements.</p>
Lessons learned	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technologies</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>Access and use of appropriate weeding tools</p>

	(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 maize young plants.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Basic costs include weeding, seeds and tool which approximately 20,000 per acre for ordinary macadamia-maize.
Estimated returns	KSH 2,200,000/ per acre green maize depending on market.
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women employment in mechanical weeding</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• VMGs will benefit from consumption of health macadamia hence improved nutrition</li> </ul>
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for macadamia farming than men</li> <li>• Women and youth have limited access to education, training and extension services</li> </ul>

	than men
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women employment in mechanical weeding</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Tharaka nithi.
Application guidelines for users	ToT Manuals to include weed management TIMPs.
F: <b>Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Validation 3. Requires further research)	1) Ready for up-scaling
<b>G: Contacts</b>	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi, Dr Violet Momanyi, Antony Nyaga.
Partner organizations	MoALF in Counties

<b>TIMP Name</b>	<b>Crop Rotation in Macadamia</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<p>Diverse weed spp. and rich weed seed banks in Macadamia cropping systems contribute to high weed losses due to weeds.</p> 
What is it? (TIMP description)	A good successive weed control strategy starting with a Farm Plan with a rotation schedule incorporated for

	<p>optimal macadamia production. This is a planned sequence of crops growing same field year after year. Land is divide into a number of distinct areas. Keep plants of same type together. eg Watermelon – Peas – Pursley - carrot or onions. Rotation adds diversity to the cropping system, increase sustainability, of the system and provides the foundation of long term weed management.</p> <p>Sow certified melon seeds in rows or transplant watermelon seedlings into a clean weed free seed bed. Rotation is the most critical time for obtaining good crop weed control but emphasize before making decision should be on environment, weeds present, time of year, crop rotation, irrigation methods and herbicide cost. Good rotation is achieved by combining cultural and herbicide weed management strategies. Two options</p> <p>1. Form beds well before planting. Flush weeds grow. Knock them down with a post emergence herbicide or shallow weeding. 2. Form beds just before planting. Remove any emerged weeds. Or use pre-plant herbicides such as (glyphosate, paraquat and diquat) depending on weeds present, stage of weed growth and herbicide cost. You can start by applying appropriate herbicide targeting specific weeds on your land eg Glyphosate 0.3-1.0. Use hooded spray and direct to row middles When weeds are small this reduces weeding costs.</p> <p>Detailed weed information (annual broad leaved or grasses) recoded or maps kept over time will help improve management decision in crop rotation.</p>
Justification	Planting a wide variety of crops with varied characteristics reduces the likelihood that specific weed species will become adapted to the system and become problematic. The successive rotation systems for weed

	<p>suppression appears to be based on the use of crop sequences that employ varying patterns of resources competition, allelopathy interference, soil disturbance and mechanical damage to provide an unstable and frequently inhospitable environment that provides the proliferation of a particular weed species. Correct timely Crop Rotation minimizes weeds population in macadamia crop and reduces weed seed banks so there is less future infestations. Different crops grown in rotation break the cycle of weeds. The diversity of weed management strategies used for different crops also increases weed diversity and reduces prevalence of problem weeds that can build over time. Planting dates are important. The most effective management must be made before crop is planted and this is taken care of when planning the rotation.</p>
Region promoted	All areas where macadamia are grown.
Counties where TIMP will be upscaled	Meru
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
	

	<i>Farmers learning on weeds in the a weedy field</i>
Critical/essential factors for successful promotion	Applied and adaptive Research to test, validate and release rotation practice in maize varieties A platform for interaction of macadamia value chain stakeholders Anticipatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –[MOALF&amp;I) for extension,</li> <li>• Jua Kali artisans</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Current extent of reach	Limited research done on appropriate rotations for maize systems.
Challenges in dissemination	Lack of macadamia 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 macadamia not readily available.
Suggestions for addressing the challenges	Establish macadamia 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 maize growing regions.
Lessons learned	Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform

	<p>Creation of awareness through demonstrations and farmer field days help in adoption of the varieties</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>Use of appropriate crop rotation will provide timely weed control which will enhance crop production.</p>
Social, environmental, policy and market conditions necessary	Sensitization of communities on the crop rotation practices in weed management
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Basic cost of crop rotation for macadamia farmers: hand weeding expensive in short run but longer benefits in reduced seed banks.
Estimated returns	Not yet estimated
Basic costs	Basic cost of crop rotation for macadamia farmers: hand weeding expensive in short run but longer benefits in reduced seed banks.
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land and credit</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women in production and marketing</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seed potato cuttings</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of</li> </ul>

	awareness
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth exists in transporting the produce</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Macadamia farmers in Murang'a County.
Application guidelines for users	Production manuals to include crop rotation weed management TIMP
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Validation 3. Requires further research)	2. Ready for validation
<b>G: Contacts</b>	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi, Dr Violet Mumanyi, Antony Nyaga
Partner organizations	MoALF in Counties

<b>TIMP Name</b>	<b>Safe Use of herbicides in Macadamia</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Excessive herbicide application to crops and the soil, use of herbicides for spraying crops without wearing the right protective clothing, storage of herbicides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, and use without following the guidelines provided on the labels (eg rate and Pre-Harvest Interval), disposal of expired herbicides and empty containers. Inadequate enforcement of global and national policies and regulation on use of pesticides.
What is it? (TIMP description)	Capacity building of macadamia farmers, crop protection teams on safe handling and use of herbicides right from transportation from the agro-dealers to storage in their houses, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large. The technology will include proper methodologies for proper herbicide disposal to minimize pollution of the environment.



	 <p style="text-align: center;"><i>Safety measures taken in spraying</i></p>
Justification	<p>Although reported cases of improper and misuse use of pesticides are common in many areas where macadamia 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.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Macadamia producers
Approaches used in dissemination	<p>Farmer field and business Schools (FFBS)  Agricultural Innovation Platforms (AIP)  Farmer trainings, farmer participatory demonstrations/  farmer field schools, shows, trade fairs, Plant clinics,  Pesticides spray Demonstrations.</p>
Critical/essential factors for successful promotion	<p>Applied and adaptive Research to test, validate and employ safe use herbicide application in maize varieties  A platform for interaction of maize value chain stakeholders  Development of agronomic practices for cabbage  Collaboration between all partners, willingness of farmers to adhere to proper guidelines.  Adequate facilitation: funds, logistics (transport)</p>
Partners/stakeholders for scaling up and their roles	<p>Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers, farmer groups/CBOs to participate in the implementation of the various technologies for maize production, KALRO and Universities to develop the technologies and conduct ToTs. AAK, PCPB, KEPHIS.</p>
<b>C: Current situation and future scaling up</b>	
Counties where technology is already being promoted if any	
Counties where TIMPS will be up	Meru


scaled	
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of technology</li> <li>• Labour intensity and requires skilled man power</li> <li>• Change of mindset in favour of current practices maybe difficult to achieve.</li> <li>• Illiteracy and inadequate capacity to use herbicides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of herbicides.</li> <li>• Use of banned pesticides from neighboring countries</li> <li>• Inadequate capacity by farmers and agrochemical companies to dispose herbicides (pesticides) properly</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish macadamia innovation platforms</li> <li>• Capacity building and sensitization forums for both farmers and agro dealers using participatory approach.</li> <li>• Formation of youth spray teams.</li> <li>• Establishment of aggregation centres for pesticide containers</li> <li>• Establishment of training of Extension staff and lead farmers as TOT.</li> <li>• Increase surveillance along the border points and enforce the laws.</li> </ul>
Lessons learned in upscaling if any	<p>Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</p> <p>Creation of awareness through demonstrations and farmer field days help in adoption of the technologies</p> <p>Availability of market is essential</p> <p>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</p> <p>Upscaling of this technology needs young men and youth due to its hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collection and incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of herbicides in some areas.</p>
Social, environmental, policy and market conditions necessary	Organized collective marketing channels critical for benefits to be derived from practice
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES - per acre
Estimated returns	KES - per acre
Gender issues and concerns in development,	<ul style="list-style-type: none"> <li>• Technology is not safe for use by expectant women</li> </ul>

dissemination,adoption and scaling up	<p>and the physically challenged individuals because of it hazardous/dangerous nature.</p> <ul style="list-style-type: none"> <li>• Herbicides and protective gear are expensive and most women may not afford them.</li> <li>• Lack of knowledge by men and women on the dangers of herbicides especially on storage and disposal.</li> <li>• Low levels of illiteracy and inability to read and interpret the content of the herbicide labels especially on re-entry period after spraying and PHI. This can cause herbicides poisoning to get into contact.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Formation of spray teams by men</li> <li>• Formation of surveillance/scouting groups by women</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• These are dangerous products that may not be handled by vulnerable groups.</li> <li>• Herbicides are expensive for most youths and physically challenged groups that may not utilize them.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Youths to offer spray calibration services to farmers as an enterprise.</li> <li>• Youths to help in the collection of pesticide containers and assist in the incineration processes by AAK.</li> <li>• Youth to own and operate agro chemicals that stock right pesticides and offer advisory services to farmers at the agroveter shops</li> </ul>
Gender issues and concerns in development, dissemination,adoption and scaling up	
Gender related opportunities	<ul style="list-style-type: none"> <li>• Formation of spray teams by men</li> <li>• Formation of surveillance/scouting groups by women</li> </ul>
VMG issues and concerns in	<ul style="list-style-type: none"> <li>• These are dangerous products that may not be</li> </ul>

development, dissemination, adoption and scaling up	<p>handled by vulnerable groups.</p> <ul style="list-style-type: none"> <li>• Herbicides are expensive for most youths and physically challenged groups that may not utilize them.</li> </ul>
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling
<b>F: Contacts</b>	
Contacts	Centre Director KALRO Kabete
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr Violet Momanyi, Antony Nyaga
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

## 2.8 Post Harvest Handling of Macadamia

<b>2.7.1 TIMP Name</b>	<b>Harvesting</b>
Category (i.e. technology, innovation or management practice)	<p style="text-align: center;"><b>Management Practice</b></p> <div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: center;"><i>Harvesting is done by collecting fallen nuts from under the tree</i></p>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<p>Losses due to:</p> <ul style="list-style-type: none"> <li>➤ incorrect harvesting stage</li> <li>➤ inappropriate harvesting methods</li> </ul>
What is it? (TIMP description)	<p>This is a management practice involving determination of maturity indices and harvesting procedure.</p> <p><u>Maturity indices:</u> Macadamia nuts are harvested after they drop to the ground and hence should never be picked from the tree.</p> <p><u>Harvesting:</u></p>




 <p>Base from where the fallen nuts are collected</p>	<ul style="list-style-type: none"> <li>➤ Harvesting of macadamia is done manually by collecting the nuts after they drop to the ground.</li> <li>➤ Collection is done at least twice a week.</li> <li>➤ The base of the tree where the nuts fall should be clear of any debris.</li> </ul>
<p>Justification</p>	<p>Improper harvesting stage, inappropriate harvesting methods leads to losses of macadamia nut quality. This results in the nuts fetching lower prices in the market. Nuts should be collected frequently to avoid them absorbing moisture and any contamination from the soil which would encourage mold growth. The above practices ensures high quality of macadamia nuts.</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Farmers , traders, processors</p>
<p>Approaches used in dissemination</p>	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Agricultural exhibitions</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Extension officers</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> </ul>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• Application of good agricultural practices to have a good crop</li> <li>• Application of good harvesting and postharvest handling technologies</li> </ul>
<p>Partners/stakeholders for scaling up and their roles</p>	<ul style="list-style-type: none"> <li>• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations</li> <li>• Market players to create demand and pull production</li> <li>• Farmer leaders: Group organization</li> <li>• NGOs dealing with Macadamia to disseminate the practices</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted if any</p>	<p>Embu, Murang’a, Kirinyaga, Kiambu, Taita Taveta, Meru</p>
<p>Counties where TIMP will be up scaled</p>	<p>-Meru</p>
<p>Challenges in dissemination</p>	<p>Lack of knowledge in appropriate harvesting technology          Negative attitude by farmers towards adoption of new agricultural TIMPs          Need for quick money          Low uptake before the farmers see results</p>
<p>Suggestions for addressing the challenges</p>	<p>Capacity building of farmers and traders on macadamia harvesting and post-harvest handling technologies</p>

	Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in upscaling if any	Create awareness to farmers on cost implication of poor harvesting and postharvest handling practices
Social, environmental, policy and market conditions necessary for development and upscaling	Opportunities for increased returns due to appropriate harvesting and post-harvest handling technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Reduced losses and hence better income (due to appropriate harvesting technologies)
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women may not be able to perform the task due to the height of the crop</li> <li>• Women and youth have limited access credit to purchase the harvesting implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities in harvesting exist for the youths</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may not be able to perform the task due to their disability</li> <li>• VMGs and youth have limited access credit to purchase the harvesting implements</li> <li>• VMGs and youth have limited access to education, training and extension services than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities in harvesting exist for the youths</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	
Application guidelines for users	Macadamia harvesting leaflets and manuals
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling

<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiro S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

**Research gaps:**

1. Upscaling on harvesting technologies of macadamia nuts
2. Quantification of the losses due to; inappropriate harvesting, delay in collection from the field.

<b>2.7.2 TIMP name</b>	<b>Dehusking</b>
Category (i.e. technology, innovation or management practice)	<p><b>Management practice</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Demonstration of a hand operated dehusker</p> </div> <div style="text-align: center;">  <p>A farmer showing his commercial motorized Jua Kali dehusker</p> </div> </div>
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<ul style="list-style-type: none"> <li>• Delayed dehusking provides an environment for mold growth and hence affecting the quality of the nut</li> </ul> <div style="text-align: center;">  <p><i>Farmers dehusking nuts using the traditional pestle &amp; mortar</i></p> </div>


What is it? (TIMP description)	This is a management practice involving timely dehusking of macadamia to prevent quality deterioration.
Justification	Macadamia nuts are dehusked immediately they are collected. The dehusking can be manual or mechanical using a dehusking machine. High Post-harvest losses/reduced quality due to mold growth and discoloration of the kernel as a result of delayed dehusking. At the same time, dehusking should be done immediately to avoid the buildup of moisture between the husk and the shell which can also affect the quality of the kernel.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia producers/farmers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Agricultural exhibitions</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Extension officers</li> <li>• Mass media – Agricultural programs</li> </ul> Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	Application of good agricultural practices to have a good crop. Application of timely dehusking methods, either manual or mechanical.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations</li> <li>• Market players to create demand and pull production</li> <li>• Farmer leaders: Group organization</li> </ul> NGOs dealing with Macadamia to disseminate the practices
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Embu, Murang'a, Kirinyaga, Kiambu, Taita Taveta, Meru
Counties where TIMP will be up scaled	Meru
Challenges in dissemination	Lack of knowledge on importance of timely dehusking
Suggestions for addressing the challenges	Capacity building of farmers and traders on macadamia dehusking technologies. Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in upscaling, if any	Create farmers awareness on the benefits of timely dehusking practice
Social, environmental, policy	Opportunities for increased returns due to appropriate

and market conditions necessary	dehusking technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	None
Estimated returns	Reduced losses and hence better income (due to appropriate timely dehusking technologies)
Gender issues and concerns in development and dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the youths and women on performing manual dehusking</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may not be able to perform the task due to their disability</li> <li>• VMGs and youth have limited access credit to purchase the harvesting implements</li> <li>• VMGs and youth have limited access to education, training and extension services than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the youths in performing the operation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from similar previous projects	Increased quality of the nuts leading to increased income
Application guidelines for users	Macadamia dehusking leaflets and manuals
<b>F: Status of TIMP readiness</b> (1. Ready for upscaling; 2. Requires validation; 3. Requires further research	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth

	W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

### Research gaps:

1. Upscaling on dehusking technologies of macadamia nuts
2. Quantification of the losses due to delay in dehusking.


<b>2.7.1 TIMP Name</b>	<b>Macadamia NIS Drying</b>
Category (i.e. technology, innovation or management practice)	<b>Management Practice</b>
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Losses due to improper and delayed drying.
What is it? (TIMP description)	This is a management practice involving drying of the in shell nuts. <ul style="list-style-type: none"> <li>➤ Macadamia nuts should be dried after dehusking.</li> <li>➤ The drying can be under shade (not direct sunlight) in a well aerated environment or in forced air.</li> <li>➤ Nuts should be dried to less than 14% moisture content for storage and less than 4% for cracking.</li> <li>➤ The drying can be done by just spreading the nuts on mats outside or on trays.</li> </ul>
 <i>Drying of nuts on trays inside a store</i>	
Justification	The drying of the nuts should be done to reduce the field moisture content from about 25% to 14% which is safe for storage. The above practices ensures easier cracking and high quality macadamia nuts.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers , traders, processors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Agricultural exhibitions</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Extension officers</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Application of timely and proper drying regimes to ensure good quality nuts</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations</li> <li>• Market players to create demand and pull production</li> <li>• Farmer leaders: Group organization</li> <li>• NGOs dealing with Macadamia to disseminate the practices</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Murang'a, Kirinyaga, Kiambu, Taita Taveta, Meru
Counties where TIMP will be up scaled	-Meru
Challenges in dissemination	Lack of knowledge on the importance of timely drying Need for quick money Low uptake before the farmers see results
Suggestions for addressing the challenges	Capacity building of farmers on macadamia drying. Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in upscaling if any	Create awareness to farmers on cost implication of not drying their nuts in time.
Social, environmental, policy and market conditions necessary for development and upscaling	Opportunities for increased returns due to timely and appropriate drying technologies.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Reduced losses and hence better income (due to appropriate drying technologies)
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the youths and women in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may not be able to perform the task due to their disability</li> <li>• VMGs and youth have limited access credit to purchase the required implements</li> <li>• VMGs and youth have limited access to education, training and extension services than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge</li> </ul>

VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the youths in performing the operation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	
Application guidelines for users	Macadamia drying leaflets and manuals
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcri@kalro.org">director.fcri@kalro.org</a>

**Research gaps:**

1. Upscaling on drying technologies of macadamia nuts
2. Quantification of the losses due to; inadequate reduction in moisture during drying.

<b>2.7.3 TIMP Name</b>	<b>Grading of macadamia NIS</b>
Category (i.e. technology, innovation or management practice)	Technology
	
<b>A: Description of the technology, innovation</b>	<i>NIS Roller Drum Size grader</i>
Problem to be addressed	If the nuts are not size graded before cracking, a lot of breakage is noticed leading to losses in quality and hence low prices
What is it? (TIMP description)	Grading macadamia is done according to size for ease of cracking. It is done by use of drum graders or through conveyor belts

 <p>Macadamia size grader</p>	
Justification	Grading of macadamia allows different sizes of nuts to be cracked without unnecessary breakages leading to more whole kernels that fetch the processors better prices.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers , traders, processors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Agricultural exhibitions</li> <li>• Agricultural shows</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Application of good agricultural practices to have a good crop</li> <li>• Application of grading technologies</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Market players to create demand and pull production</li> <li>• Farmer leaders: Group organization</li> <li>• NGOs dealing with macadamia to disseminate the practices</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Murang’a, Kiambu
Counties where TIMP will be up scaled	Meru
Challenges in dissemination	Lack of knowledge on appropriate grading technology
Suggestions for addressing the challenges	Awareness creation about the technology to processors Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in upscaling if any	Field grading of nuts is difficult as farmers do not have grades. In addition, the prices for the different sizes is the same hence the grading is done at processors level
Social, environmental, policy and market conditions necessary for development and upscaling	Opportunities for increased returns due to grading technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income (due to appropriate grading technologies)
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youths have less access to the grading implement than men</li> </ul>

	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth in the operation of the TIMP</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have less access to the grading implement than men</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth and those recovering from drugs exists in the operation of the TIMP</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	
Application guidelines for users	Macadamia grading leaflets, factsheets and manuals
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fciri@kalro.org">director.fciri@kalro.org</a>

Research gap

- Validation of mechanized grading of macadamia

- Further research on grading technologies

<b>2.7.3 TIMP Name</b>	<b>Macadamia NIS Storage</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<p>The reduction of the shelf life of macadamias is largely the result of poor handling and storage procedures, both on the farm and at the processor level.</p> <p>An acceptable shelf-life term can be achieved by the conscious effort and loyal collaboration of both the farmer and the processor.</p> <div> </div> <div> <p>NIS stored in Net</p> </div> <div> </div> <div> <p>NIS stored in Sisal Gunny</p> </div>
What is it? (TIMP description)	<p>This is a management practice involving the storing of the dried macadamia nuts.</p> <ul style="list-style-type: none"> <li>• When harvested, nuts should be stored in raised sisal bags and not polythene bags.</li> <li>• The bags are well-laid out on timber planks to ensure they do not get into contact with water.</li> <li>• Storing at home for long can compromise quality. The nuts can develop moulds, just as they do when harvested immature.</li> <li>• The nuts can also be stored in silos as they further dry to 10–15% moisture content for longer-term storage and for most efficient cracking of the shell.</li> </ul>
Justification	<p>Proper storage of Macadamia Nuts is critical to having a crunchy, tasty nut to eat.</p> <p>They should be stored in well aerated rooms far</p>

	from water/moisture
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers , traders, processors
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Agricultural exhibitions</li> <li>• Agricultural shows</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Application of good agricultural practices to have a good crop</li> <li>• Application of appropriate storage technologies</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Market players to create demand and pull production</li> <li>• Farmer leaders: Group organization</li> <li>• NGOs dealing with macadamia to disseminate the practices</li> <li>• Processors</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Murang'a, Kiambu, Kirinyaga, Taita Taveta
Counties where TIMP will be up scaled	Meru
Challenges in dissemination	Lack of knowledge on appropriate storage technologies
Suggestions for addressing the challenges	<p>Awareness creation to the processors on storage technology and the importance of proper storage of the nuts</p> <p>Availing data on the economics and the gains to be made through adoption of the TIMP</p>
Lessons learned in upscaling if any	
Social, environmental, policy and market conditions necessary for development and upscaling	Opportunities for increased returns due to storage technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income (due to appropriate storage technologies)
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist youth in the operation of the TIMP</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth and those recovering from drugs exists in the operation of the TIMP</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	All Macadamia growing areas of Kenya
Application guidelines for users	Macadamia storage leaflets, factsheets and manuals
<b>F: Status of TIMP readiness</b> (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcrl@kalro.org">director.fcrl@kalro.org</a>

Research gap

- Validation of storage material of macadamia nuts
- Further research on storage technologies

## 2.9 Value Addition in Macadamia


<b>2.8.1 TIMP name</b>	<b>Macadamia cracking of NIS</b>
Category (i.e. technology, innovation or management practice)	<b>Technology</b>
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Macadamia value addition starts with cracking of the shell to remove kernels, roasting, salting and honey coating the nuts,

	before packaging for consumption. High broken level due to inappropriate cracking methods and use of ungraded nuts
What is it? (TIMP description)	This is a technology of cracking macadamia nut in order to separate the kernel from the shell.  Once the nuts are dried you can either store them or crack them. A specially designed cracker breaks the rock hard shell with minimal damage to the delicate kernel. Both shell fragments and kernel travel pass through an air separation system and through modern, hi-tech, electronic color sorters which separate the shell fragments from the kernel. The cracking can be manual (use of small hammers) or mechanical (use of cracking machines).
Justification	Cracking of the nuts is essential to separating the kernel from the shell. If the nuts are not cracked by use of appropriate technology then there is the danger of having many pieces instead of whole nuts that fetch better prices.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Traders, industrial and commercial processors
Approaches to be used in dissemination	Agricultural innovation platform, Practical demonstrations, Training workshop and seminars, Agricultural shows.
Critical/essential factors for successful promotion	Nuts to have been dried to the right moisture content for ease of cracking Local artisans can be trained on fabrication, repair and maintenance of the crackers
Partners/stakeholders for scaling up and their roles	Famers- to adopt the drying practices Artisans - to fabricate the nut crackers Processors- to use the right equipment for cracking
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Kiambu, Embu, Murang'g'a, Kirinyaga
Counties where TIMPs will be up scaled	Meru,
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of funds to acquire the crackers as they are a bit expensive</li> <li>• Challenges of high electric bill in running the cracker</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Fabrication of cheaper crackers by the Jua Kali artisans</li> <li>• Provision of loans/capital to farmers' groups and private processors to acquire the crackers</li> <li>• Capacity building of local artisans on fabrication and maintenance of these crackers</li> </ul>
Lessons learned in upscaling, if any	
Social, environmental, policy and market conditions necessary for development and upscaling	- Opportunities for increased returns due to cracking technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	

Estimated returns	Increased incomes due to reduced broken and reduced postharvest losses
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youths usually perform the task of cracking the nut. Consequently the technology may not be adopted if women are already overwhelmed with other chores</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth who usually perform this task</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunity to produce, trade in, and consume locally produced macadamis based products</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
Application guidelines for users	Macadamia cracking guidelines and brochures and leaflets
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

### Research Gaps

1. Low information on how/where to source the crackers
2. Further research on the cracker fabrication


<b>2.8.2 TIMP name</b>	<b>Macadamia roasting (Kernels)</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High/low roasting temperatures Inadequately dried macadamia nuts
What is it? (TIMP description)	This is a technology of roasting macadamia kernels in preparation for consumption or further processing. The cracked nuts are dried in an oven to a moisture content below 4%. After cracking and separation of shell from kernel, the kernel is lightly roasted in an oven at 100 °C to a golden brown color. The dried kernels can also be deep fried in oil like coconut oil
	
Macadamia roasting equipment	
Justification	For the flavor of macadamia nuts to be enjoyed, the nuts are roasted in an oven or deep fried in edible oil and hence the importance of this technology. Roasting also diversifies the usage of macadamia nuts as this allows it to be consumed as a snack.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm demonstration, field days, agricultural shows and exhibitions, promotional materials (posters/brochures/ leaflets)
Critical/essential factors for successful promotion	Capacity building of the stakeholders on the right temperature regimes. Availability of roasting standards
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers– to appreciate the importance of producing the right nuts for roasting</li> <li>• Extension service providers (Public and private) to help in the dissemination</li> <li>• KEBS – Standards formulation for macadamia roasting standards</li> <li>• Processors</li> <li>• National and County governments</li> <li>• Financial institutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Embu, Kiambu, Murang’a, Kirinyaga
Counties where TIMPs will be up scaled	Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited awareness of the technology by processors</li> <li>• Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product</li> <li>• Availability of the processors for awareness creation</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the roasting standards</li> <li>• Capacity building of processors on macadamia roasting regimes</li> <li>• Involvement of regulatory agencies and policy makers in up-scaling process</li> </ul>
Lessons learned in upscaling, if any	
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Increase production of macadamia will attract more investors to invest in this industry and hence make more roasted nuts available in the market resulting in reduced prices of roasted macadamia and hence affordable to many.</p> <p>There is need to develop quality standards for macadamia roasting to propel its commercialization even by farmer groups</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	Better quality roasted nuts and hence increased income, enhanced nutrition status from increased consumption of roasted macadamia nuts
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth who usually perform this task</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Macadamia is a nutritionally rich product that can help improve the nutrition status of the VMGs on consumption.</li> <li>• The micro-nutrients in macadamia are particularly healthy for VMGs</li> <li>• Opportunity for women to process, consume and trade in roasted macadamia</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Macadamia is a nutritionally rich product that can help improve the nutrition status of the VMGs on consumption.</li> <li>• The micro-nutrients in macadamia are particularly healthy for VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	All macadamia growing areas
Application guidelines for users	Macadamia roasting technology factsheets, leaflets and manuals
<b>F: Status of TIMP readiness</b> (1- Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling

<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcrl@kalro.org">director.fcrl@kalro.org</a>

### Research gaps

1. Validation of roasting regimes
2. Development of roasted macadamia roasting quality standards

<b>2.8.3 TIMP name</b>	<b>Roasted salted Macadamia Kernels</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High/low roasting temperatures Inadequately dried macadamia nuts
What is it? (TIMP description)	This is a technology of salting and roasting macadamia kernels in preparation for consumption or further processing. The cracked nuts are dried in an oven to a moisture content below 4%. After cracking and separation of shell from kernel, the kernel are dipped in a 10% brine, dried and then lightly roasted in an oven at 100 °C to a golden brown color. The dried salted kernels can also be deep fried in oil e.g coconut oil.
 Salted roasted macadamia	
Justification	For the flavor of macadamia nuts to be enjoyed, the nuts are salted and roasted in an oven or deep fried in edible oil and hence the importance of this technology. Salting and roasting of macadamia also increases the product range of macadamia nuts
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm demonstration, field days, agricultural shows and exhibitions, promotional materials


	(posters/brochures/ leaflets)
Critical/essential factors for successful promotion	Capacity building of the stakeholders on the right amount of salt to be used (concentration of the brine) and temperature regimes for roasting. Availability of salting and roasting standards
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers– to appreciate the importance of producing the right nuts for salting and roasting</li> <li>• Extension service providers (Public and private) to help in the dissemination</li> <li>• KEBS – Standards formulation for macadamia salting and roasting</li> <li>• Processors</li> <li>• National and County governments</li> <li>• Financial institutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Embu, Kiambu, Murang'a, Kirinyaga
Counties where TIMPs will be up scaled	Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited awareness of the technology by processors</li> <li>• Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product</li> <li>• Availability of the processors for awareness creation</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the salting and roasting standards</li> <li>• Capacity building of processors on macadamia salting and roasting temperature regimes</li> <li>• Involvement of regulatory agencies and policy makers in up-scaling process</li> </ul>
Lessons learned in upscaling, if any	
Social, environmental, policy and market conditions necessary for development and upscaling	Increase production of macadamia will attract more investors to invest in this industry and hence make more salted and roasted nuts available in the market resulting in reduced prices of roasted macadamia and hence affordable to many. There is need to develop quality standards for salted and roasted macadamia to propel its commercialization even by farmer groups
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	Better quality salted and roasted nuts and hence increased income, enhanced nutrition status from increased consumption of salted and roasted macadamia nuts
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household</li> </ul>

	and community levels
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Macadamia is a nutritionally rich product that can help improve the nutrition status of the VMGs on consumption.</li> <li>• The micro-nutrients in macadamia are particularly healthy for VMGs</li> <li>• Opportunity for women to process, consume and trade in salted macadamia</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	All Macadamia growing areas
Application guidelines for users	Macadamia salted and roasting technology factsheets, leaflets and manuals
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

### Research gaps

1. Validation of salting and roasting temperature regimes
2. Development of salted and roasted macadamia quality standards

<b>2.8.4 TIMP name</b>	<b>Honey coated Macadamia Kernels</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	


Problem addressed	High/low roasting temperatures Over sweetening of the nuts Inadequately dried macadamia nuts
What is it? (TIMP description)	This is a technology of coating macadamia kernels with honey in preparation for consumption or further processing. The cracked nuts are dried in an oven to a moisture content below 4%. After cracking and separation of shell from kernel, the kernel are coated with honey and then lightly roasted in an oven at 100 °C to a golden brown color.
 Honey coated macadamia	
Justification	For the flavor of macadamia nuts to be enjoyed, the nuts are coated with honey and then roasted in an oven and hence the importance of this technology. Coating of macadamia with honey also increases the product range of macadamia nuts
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm demonstration, field days, agricultural shows and exhibitions, promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	Capacity building of the stakeholders on the right amount of honey to be used (to avoid over sweetening) and temperature regimes for roasting. Availability of honey coating and roasting standards
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers– to appreciate the importance of producing the right nuts for honey coating and roasting</li> <li>• Extension service providers (Public and private) to help in the dissemination</li> <li>• KEBS – Standards formulation for honey coating and roasting of macadamia</li> <li>• Processors</li> <li>• National and County governments</li> <li>• Financial institutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Embu, Kiambu, Murang'a, Kirinyaga
Counties where TIMPs will be up scaled	Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited awareness of the technology by processors</li> <li>• Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product</li> <li>• Availability of the processors for awareness creation</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the honey coating and roasting standards</li> <li>• Capacity building of processors on macadamia honey coating and roasting temperature regimes</li> </ul>

	<ul style="list-style-type: none"> <li>• Involvement of regulatory agencies and policy makers in up-scaling process</li> </ul>
Lessons learned in upscaling, if any	
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Increase production of macadamia will attract more investors to invest in this industry and hence make more honey coated and roasted nuts available in the market resulting in reduced prices of roasted macadamia and hence affordable to many.</p> <p>There is need to develop quality standards for honey coating and roasting macadamia to propel its commercialization even by farmer groups</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	Better quality honey coated and roasted nuts and hence increased income, enhanced nutrition status from increased consumption of honey coated and roasted macadamia nuts
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Macadamia is a nutritionally rich product that can help improve the nutrition status of the VMGs on consumption.</li> <li>• The micro-nutrients in macadamia are particularly healthy for VMGs</li> <li>• Opportunity for women to process, consume and trade in honey coated macadamia</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Macadamia processing units
Application guidelines for users	Macadamia honey coating and roasting technology factsheets, leaflets and manuals
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN.,

	Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcrl@kalro.org">director.fcrl@kalro.org</a>

### Research gaps

1. Validation of honey coating and roasting temperature regimes
2. Development of honey coated and roasted macadamia quality standards

<b>2.8.5 TIMP name</b>	<b>Chocolate coated Macadamia Kernels</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High/low roasting temperatures Over coating with chocolate Inadequately dried macadamia nuts
What is it? (TIMP description)	This is a technology of coating macadamia kernels with chocolate in preparation for consumption or further processing. After roasting the kernel at 100 °C, they are mechanically coated with chocolate, allowed to settle and packed.
	
<i>Chocolate coated macadamia</i>	
Justification	Roasted macadamia nuts are coated with chocolate and hence the importance of this technology. Coating with chocolate diversifies the usage of macadamia nuts as this allows it to be consumed as a snack.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm demonstration, field days, agricultural shows and exhibitions, promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	Capacity building of the stakeholders on the quantity of chocolate and right temperature regimes.

	Availability of chocolate coating standards
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers– to appreciate the importance of producing the right size of nuts for coating</li> <li>• Extension service providers (Public and private) to help in the dissemination</li> <li>• KEBS – Standards formulation for macadamia chocolate coating standards</li> <li>• Processors</li> <li>• National and County governments</li> <li>• Financial institutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Embu, Kiambu, Murang'a, Kirinyaga
Counties where TIMPs will be up scaled	Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited awareness of the technology by processors</li> <li>• Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product</li> <li>• Availability of the processors for awareness creation</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the roasting standards</li> <li>• Capacity building of processors on macadamia roasting regimes</li> <li>• Involvement of regulatory agencies and policy makers in up-scaling process</li> </ul>
Lessons learned in upscaling, if any	
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Increase production of macadamia will attract more investors to invest in this industry and hence make more chocolate coated nuts available in the market resulting in reduced prices of chocolate coated macadamia and hence affordable to many.</p> <p>There is need to develop quality standards for macadamia chocolate coating to propel its commercialization even by farmer groups</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	Better quality chocolate coated nuts and hence increased income, enhanced nutrition status from increased consumption of chocolate coated macadamia nuts
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded</li> </ul>

	<p>from decision making in development and dissemination activities</p> <ul style="list-style-type: none"> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Macadamia is a nutritionally rich product that can help improve the nutrition status of the VMGs on consumption.</li> <li>• The micro-nutrients in macadamia are particularly healthy for VMGs</li> <li>• Opportunity for women to process, consume and trade in chocolate coated macadamia</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Most macadamia processing firms
Application guidelines for users	Macadamia chocolate coating technology factsheets, leaflets and manuals
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	<p>The Institute Director, KALRO-HRI Thika;  E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>  Officer in Charge, KALRO Practical Training Centre  E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>  The Centre director, KALRO-Kabete;  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>  The Institute director, KALRO-FCRI Kitale;  E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>

### Research gaps

1. Validation of chocolate coating and roasting temperature regimes
2. Development of chocolate coated macadamia quality standards

<b>2.8.6 TIMP name</b>	<b>Packaging of processed Macadamia Kenels</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Macadamia being a highly susceptible product to moisture, light and oxygen, how it's packaged is very crucial.
What is it? (TIMP description)	<p>This is a technology of packaging macadamia kernels in preparation for consumption, transportation and storage or for further processing.</p> <p>The packaging is for raw kernels and value added kernels. Kernels are packaged raw in bulk in vacuum-filled, foil-laminate bags that help to prevent development of rancidity.</p>


	The packaged product is then kept in cold storage to prolong shelf-life. Under these conditions, kernel can be safely stored for at least a year.
Justification	Packaging of macadamia kernels determines the shelf life of these products. The reduction of the shelf life of macadamias is largely the result of poor handling and storage procedures, both on the farm and at the processor level and hence should be a serious consideration.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, industrial and commercial processors
Approaches to be used in dissemination	On-farm demonstration, field days, agricultural shows and exhibitions, promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	Capacity building of the stakeholders on the best bet method of packaging macadamia Availability of packaging standards
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers– to appreciate the importance of handling the raw nuts at their node as this contributes to the final quality of the product</li> <li>• Extension service providers (Public and private) to help in the dissemination</li> <li>• KEBS – Standards formulation for the right packaging standards</li> <li>• Processors</li> <li>• National and County governments</li> <li>• Financial institutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Embu, Kiambu, Murang’a, Kirinyaga
Counties where TIMPs will be up scaled	Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited awareness of the technology by processors</li> <li>• Availability of the processors for awareness creation</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the packaging standards</li> <li>• Capacity building of processors on macadamia packaging</li> <li>• Involvement of regulatory agencies and policy makers in up-scaling process</li> </ul>
Lessons learned in upscaling, if any	
Social, environmental, policy and market conditions necessary for development and upscaling	Opportunities for increased returns due to appropriate technologies
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	Greater shelf life for the properly packaged macadamia and hence increased income, enhanced safe food

Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Men dominant most decisions at the household and community levels</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women and youth in performing the operation</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Macadamia is a nutritionally rich product that can help improve the nutrition status of the VMGs on consumption.</li> <li>• The micro-nutrients in macadamia are particularly healthy for VMGs</li> <li>• Opportunity for women to process and trade in the product</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
Application guidelines for users	Macadamia packaging technology factsheets, leaflets and manuals
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	KALRO Scientists Kiiru S., Antony N., Muriuki SJN., Japheth W., Watani G., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Lead organization and scientists	The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a> Officer in Charge, KALRO Practical Training Centre E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a> The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a> The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a>

### Research gaps

1. Research on cheaper packaging technologies


## 2.10 Mechanization of Macadamia Production Activities

<b>2.9.1 TIMP Name</b>	Grafting machine
Category (i.e. technology, innovation or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• Slow and tedious processes of seedling grafting, in a commercialized Macadamia commodity</li> <li>• Reduced capacity due to manual digging drudgery</li> <li>• High cost of manual labour</li> </ul>
What is it? (TIMP description)	<div style="text-align: center;">  </div> <ul style="list-style-type: none"> <li>• It is a fruit and vegetable grafting robot.</li> <li>• It is a robot that grafts fruits and vegetables of the cucurbitaceae and solanaceae, flowers and trees.</li> <li>• It automatically grafts species that guarantee rich and high-quality harvesting and are strong against diseases.</li> </ul>
Justification	<ul style="list-style-type: none"> <li>• The machine is consistent in cut angle</li> <li>• The cutting blades are automatically disinfected after each cycle</li> <li>• Allows grafting of small plants</li> <li>• The machine works faster with a capacity to graft over 800 plants per hour.</li> <li>• High percentage of uptake.</li> <li>• Grafting is the fastest way of growing popular, desirable varieties of fruiting trees and flowering shrubs on a large scale.</li> <li>• Many commercially valuable plants are difficult to grow by other propagation methods like cutting and layering, but they respond well to grafting.</li> <li>• Cost effective</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

Users of TIMP	Macadamia farmers and researchers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and adopt if appropriate</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, Universities (for information)</li> <li>• Machinery fabricators</li> <li>• NGO supporting farmers for dissemination</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Machakos, Kwale, Kilifi, Lamu, Tana-River, Baringo, West Pokot
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Lack of appropriate machines for different farm activities</li> <li>• High initial cost for a grafting</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Acquisition of the machines</li> <li>• Avail facilitation to demonstration site</li> <li>• Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Mechanization in agriculture increases production</li> <li>• Mechanization releases labour to alternative requirement areas</li> <li>• Provides low cost farm operations</li> </ul>
Social, environmental, policy and market	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in agricultural production</li> <li>• Include all gender groups in research, and validation.</li> </ul>

conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 1,200,000
Estimated returns	KES 500,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in operating the implement</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase farm implements such as the grafting machine</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the implement</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos


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Lead organization and scientists	KALRO, Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators

<b>2.9.2 TIMP Name</b>	<b>Mould board plough</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• Slow and tedious processes of seedbed preparation, in a commercialized Macadamia commodity</li> <li>• Reduced capacity due to manual digging drudgery</li> <li>• High cost of manual labour</li> </ul>
What is it? (TIMP description)	 <ul style="list-style-type: none"> <li>• Mouldboard plough is the most efficient tillage implement for seed bed preparation and weed eradication. A plough that has a mouldboard, coulter, which a sharp steel wedge that precedes the plough and cuts vertically through the soil.</li> </ul>
Justification	<ul style="list-style-type: none"> <li>• High Efficiency. When well-adjusted, the plough automatically seeks the desired depth by itself.</li> <li>• Versatility. The various models have different features that enable high efficiency in preparation of the land.</li> <li>• Pest Control.</li> <li>• Improves Soil Health.</li> </ul>

<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia farmers and researchers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and adopt if appropriate</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, Universities (for information)</li> <li>• Machinery fabricators</li> <li>• NGO supporting farmers for dissemination</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Machakos, Kwale, Kilifi, Lamu, Tana-River, Baringo, West Pokot
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Lack of appropriate machines for different farm activities</li> <li>• High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Acquisition of the machines on special terms</li> <li>• Avail facilitation to demonstration site</li> <li>• Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Mechanization in agriculture increases production</li> <li>• Mechanization releases labour to alternative requirement areas</li> <li>• Provides low cost farm operations</li> </ul>
Social,	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in</li> </ul>

environmental, policy and market conditions necessary for development and upscaling	<p>agricultural production</p> <ul style="list-style-type: none"> <li>• Include all gender groups in research, and validation.</li> <li>• Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 840,000
Estimated returns	KES 150,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in operating the implement</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase farm implements such as the grafting machine</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the implement</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	


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

<b>2.9.3 TIMP Name</b>	Harrow
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• Slow and tedious processes of land preparation, in a commercialized Macadamia commodity</li> <li>• Reduced capacity due to manual digging drudgery</li> <li>• High cost of manual labour</li> </ul>
What is it? (TIMP description)	 <ul style="list-style-type: none"> <li>• Creating of a crumbly layer for planting is tedious. It is not possible to manually protect the soil surface from rapid drying.</li> <li>• Improving both the air and water penetrability into soil manually can be too expensive if manually undertaken.</li> <li>• Manual operation will reduce microbiological processes in the soil.</li> <li>• Manual land harrowing Improving of nutrient availability to plants.</li> </ul>
Justification	<ul style="list-style-type: none"> <li>• It has multiple uses and other advantages, light can be used in</li> </ul>

	<p>tree pruning and bush clearing</p> <ul style="list-style-type: none"> <li>• Preparation through cutting and burying the trash for decomposition.</li> <li>• Farm sizes less than one hectare may limit manoeuvrability of brushers</li> <li>• Manual labour is costly</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia farmers and researchers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and adopt if appropriate</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, Universities (for information)</li> <li>• Machinery fabricators</li> <li>• NGO supporting farmers for dissemination</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Machakos, Kwale, Kilifi, Lamu, Tana-River, Baringo, West Pokot
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Lack of appropriate machines for different farm activities</li> <li>• High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Acquisition of the machines by investors</li> <li>• Avail facilitation to demonstration site</li> <li>• Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption</li> </ul>

	<p>and this can be facilitated through innovation platforms</p> <ul style="list-style-type: none"> <li>• Mechanization in agriculture increases production</li> <li>• Mechanization releases labour to alternative requirement areas</li> <li>• Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in agricultural production</li> <li>• Include all gender groups in research, and validation.</li> <li>• Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 450,000
Estimated returns	KES 150,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work</li> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in operating the implement</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the implement</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice

Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<p>The Institute Director, KALRO AMRI -Katumani;  P.O. Box 340. Machakos  Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a>  Phone: 0711369535</p>
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Pole F.N.
Partner organizations	Local Fabricators


<b>2.9.4 TIMP Name</b>	Harrow
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• Slow and tedious processes of seedbed preparation, in a commercialized Macadamia commodity</li> <li>• Difficult to prepare a uniform fine tilth seedbed manually</li> <li>• Delayed operation lead to late planting</li> <li>• Low acreage because of lack of manual labour</li> <li>• High cost of manual labour</li> </ul>
What is it? (TIMP description)	

	<ul style="list-style-type: none"> <li>• 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</li> <li>• It is a cultivating tool set with used primarily for breaking up and smoothing the soil in preparation of a seedbed for small sized grain planting.</li> </ul>
Justification	<ul style="list-style-type: none"> <li>• Creating of a crumbly layer for planting is tedious.</li> <li>• It is not possible to manually protect the soil surface from rapid drying but with this harrow, it can be done.</li> <li>• Improving both the air and water penetrability into soil manually can be too expensive if manually undertaken.</li> <li>• Manual operation will reduce microbiological processes in the soil</li> <li>• Machine land harrowing Improves nutrient availability to plants.</li> <li>• Enables intercropping in Macadamia plantation to maximize space utility</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia farmers and researchers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release improved Macadamia varieties</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	<p>KALRO, Universities (for information)</p> <p>Machinery fabricators</p> <p>NGO supporting farmers for dissemination</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kwale, Kilifi, Lamu, Tana-River, Makueni, Kitui, Baringo
Counties where TIMP will be up scaled	Machakos

Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Lack of machines</li> <li>• Lack of facilitation to demonstration site</li> <li>• High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Acquisition of the machines</li> <li>• Lack of facilitation to demonstration site</li> <li>• Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Mechanization in agriculture increases production</li> <li>• Mechanization releases labour to alternative requirement areas</li> <li>• Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in agricultural production</li> <li>• Include all gender groups in research, and validation.</li> <li>• Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work</li> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in operating the implement</li> </ul>
VMG issues and	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase farm</li> </ul>


concerns in development, dissemination, adoption and scaling up	<p>implements such as a wheeled tractor</p> <ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the implement</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	<p>The Institute Director, KALRO AMRI -Katumani;  P.O. Box 340. Machakos  Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a>  Phone: 0711369535</p>
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

<b>2.9.5 TIMP Name</b>	<b>Trans planting Machine</b>
<b>Category (technology, innovation or management practice)</b>	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• High and increasing cost of manual labour.</li> <li>• Manual hole digging increases the cost of making planting holes.</li> </ul>

	<ul style="list-style-type: none"> <li>• It is slow and tedious processes.</li> <li>• It is also difficult to prepare a uniformly spaced contour ridges.</li> <li>• Delayed operation lead to late planting.</li> <li>• Manual hole digging increases the cost of hole making.</li> </ul>
What is it? (TIMP description)	 <ul style="list-style-type: none"> <li>• A macadamia seedling transplanting machine is tractor mounted</li> <li>• Has two panels on which to place seedlings</li> <li>• It meters the required spacing for planting a seedling</li> </ul>
Justification	<ul style="list-style-type: none"> <li>• Manual transplanting is inconsistency</li> <li>• Fertilizer use is not evenly distributed when manually applied</li> <li>• Machine transplanting</li> <li>• Row planting increases yields, easy to manage weeds and pests, and more importantly timely uniform and low labour requirement,</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia farmers and researchers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release improved Macadamia varieties</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Multiple usage, timeliness, efficiency and low cost</li> </ul>
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kilifi, Kwale, Lamu
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Lack of machines</li> </ul>

	<ul style="list-style-type: none"> <li>• Lack of facilitation to demonstration site</li> <li>• High initial cost for small-scale machines</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Acquisition of the machines</li> <li>• Lack of facilitation to demonstration site</li> <li>• Build capacity through efficient agricultural production to afford the cost</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Mechanization in agriculture increases production</li> <li>• Mechanization releases labour to alternative requirement areas</li> <li>• Provides low cost farm operations</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in agricultural production</li> <li>• Include all gender groups in research, and validation.</li> <li>• Appropriate policy formulation of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 400,000 (power auger digger), KES 80,000 (Tractor mounted hole digger)
Estimated returns	KES 50,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work</li> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in transplanting using the machine</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase farm implements such as a wheeled tractor</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the</li> </ul>

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


<b>2.9.6 TIMP Name</b>	<b>Motorised Sprayer</b>
Category (technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Slow and tedious processes of manual spraying of Cashew; The height of the tree requires a long projectile spray; Cashew has a high number of pests that invade leaf, flowers and nut.
What is it? (TIMP description)	 <p>A motorized <b>sprayer</b> is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop</p>

	performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers are man-portable units typically backpacks with spray guns They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron including as well as foliar fertilizers.
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before Macadamia forms a canopy, broad leafed weeds compete with Macadamia seedling for nutrients and light greatly reducing their yield. Manual sprayers are labour intensive and spraying labour is too expensive. It has lower pressure reducing its efficiency.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Farmers and agribusiness entrepreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release improved Macadamia varieties</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Use by Farmers</li> </ul>
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers (AGRA)
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kilifi, Kwale, Taita Taveta, Lamu
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Relatively high cost for individual small-scale farmer.</li> <li>• Limited awareness of the existence of machine among some farmers.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Encourage group/cooperative ownership</li> <li>• Launch and awareness campaign through demonstrations and trainings</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Products from local/indigenous crops attract huge market, yet very little is being done to promote growth</li> </ul>

Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>• Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development, dissemination, adoption and scaling up dissemination	Motorized sprayer designed for easy start and operation. Men have been drawn to spraying by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
Gender related opportunities	Mostly favours men
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Facilitation to access information</li> <li>• Affordability and easy to maintain machines</li> </ul>
VMG related opportunities	
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• User manuals and leaflets</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	
Estimated returns	KES 180,000.00/year
Gender issues and concerns in	Motorized sprayer designed for easy start and operation. Men have been drawn to spraying by the machine. This task was predominantly

development ,dissemination, adoption and scaling up dissemination	for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
<b>Gender related opportunities</b>	
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Facilitation to access information</li> <li>• Affordability and easy to maintain machines</li> </ul>
VMG related opportunities	Can create employment for VMG at local level
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
<b>Application guidelines for users</b>	
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators

<b>2.9.7 TIMP Name</b>	<b>Harvesting machine</b>
Category:	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>• Manual pruning is slower and untimely</li> <li>• High cost of labour</li> <li>• Food and water is used as fuel</li> <li>• Manual labour is diminishing</li> </ul>

What is it? (TIMP description)	
	<ul style="list-style-type: none"> <li>• The machine is run over dropped nuts on the ground where they are pick through a mesh mechanism and dropped in a hopper ahead of it</li> <li>• Nuts are transferred to a waiting trailer for further shipment to a store</li> <li>• Harvester offers efficient pick-up, easy manoeuvrability and faster pecan harvesting.</li> <li>• The basket, ejector fingers and brackets have all been re-engineered for a better Bag-A-Nut, and a better pecan harvester.</li> </ul>
Justification	<ul style="list-style-type: none"> <li>• The machine works faster</li> <li>• Discourages child labour</li> <li>• Cost effective</li> </ul>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Macadamia Farmers and agribusiness entrepreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release improved Macadamia varieties</li> <li>• A platform for interaction of Macadamia value chain stakeholders</li> <li>• Use by Farmers</li> </ul>
Partners/stakeholders for scaling up and their roles	<p>Machinery fabricators</p> <p>NGO supporting farmers (AGRA)</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if	Kilifi

any	
Counties where TIMP will be up scaled	Machakos
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Macadamia innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Relatively High cost for individual small-scale farmer.</li> <li>• Limited awareness of the existence of machine by the farming community.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Macadamia innovation platforms</li> <li>• Encourage group/cooperative ownership</li> <li>• Launch and awareness campaign through demonstrations and trainings</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Products from local/indigenous crops attract huge market, yet very little is being done to promote growth</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>• Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Macadamia harvester 125,000 KES per unit
Estimated returns	Capacity 500 Kg/ hour, Fuel 1 litre /hr (4-5 bags) Needs 3 operators per time Weeding charges: KES 300 per bag Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work</li> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in operating the implement</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase the implement</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for unemployed youth in operating the implement</li> </ul>
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	<ul style="list-style-type: none"> <li>• Women perform most of the crop production activities, therefore the implement will reduce their drudgery of work</li> <li>• Women and youth have limited access credit to purchase the required implements</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth in operating the implement</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase the implement</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-	Requires further research

requires validation; 3-requires further research)	
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W,
Partner organizations	Local Fabricators
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W Egerton University,
Partner organizations	Tecsols Ltd - Nakuru

## 2.11 Agricultural Business and Marketing

<b>2.10.1 TIMP Name</b>	<b>Business models and inclusive market development in Macadamia value chain</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Lack of drivers of macadamia production leading to market inaccessibility and low profitability
What is it? (TIMP description)	An approach to organize macadamia production based on market orientation. Producer-driven model is based on production organized by the producers themselves aimed at getting new markets, fetching higher market price, stabilize market position and extra supply volumes of macadamia. Buyer-driven model is based on production organized by the end customer companies. Intermediary-driven model is based on the production organized by an intermediary such as extension, NGOs, Research institutions, etc.
Justification	Without appropriate approach to the organization of macadamia production, farmers will lack markets, leading to the decline in production and income

	New business models that can facilitate smallholder farmers integration along the macadamia value chain are likely to positively affect their incomes. Appropriate choice of a business model will help link the macadamia farmers to high value markets thereby increasing incomes and making better their livelihoods. This document will assist smallholder farmers to adapt the most appropriate models to link them to the markets
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension (National and County levels), NGOs, Research institutions and other support agencies
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings</li> <li>• Radio</li> <li>• Television</li> <li>• Social media (What's App, Facebook, twitter)</li> <li>• Internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Acceptance of smallholder farmers to produce macadamia crop</li> <li>• Availability of investors along the value chain</li> <li>• Prices of macadamia</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> <li>• strengthening the existing assets and building a better market structure</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• <i>Farmers</i> – investments in macadamia production</li> <li>• <i>National and County extension staff</i> - Organization of farmers and technical service delivery</li> <li>• <i>NGOs</i> - Organization of farmers and service delivery</li> <li>• <i>Private sector (Processors, wholesalers, Retailers and exporters)</i>-Support in input services and providing markets for the macadamia production</li> <li>• <i>Research institutions</i>-Availing improved seeds, backstopping</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Bungoma, Kiambu, Muranga, Nyeri, and Embu
Counties where TIMPs will be up scaled	Meru
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Group dynamics</li> <li>• Limited investment by buyers</li> <li>• Prices of macadamia</li> <li>• Level of policy support</li> </ul>

	<ul style="list-style-type: none"> <li>• high transaction costs,</li> <li>• exclusion from high value markets,</li> <li>• information asymmetry and</li> <li>• non-enforcement of marketing contracts</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of marketing groups</li> <li>• Small-scale farming-Aggregation of production</li> <li>• Group dynamics-Capacity building</li> <li>• Limited investment by buyers-County government support</li> <li>• Prices of macadamia-Setting minimum price and contracting</li> <li>• Level of policy support-price policy, subsidies, inputs support</li> <li>• High transaction costs,</li> <li>• Exclusion from high value markets,</li> <li>• Information asymmetry and</li> <li>• non-enforcement of marketing contracts</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Production of macadamia without agreed buyers</li> <li>• Individual marketing instead of collective marketing</li> <li>• Growing demand for macadamia and macadamia-based products in Europe</li> <li>• The number of macadamia-producing counties has increased in the last decade from 16 in 2010 to 22 in 2020.</li> <li>• The number of macadamia processors has increased over years</li> <li>• Need to adopt contract farming as a measure to improve the quality of macadamia.</li> <li>• There are different production peaks in the different regions where macadamia is produced. For example in some counties the peak is between October and December, whereas in others, it is between March and May.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – acceptability by the farmers, group dynamics, cultures. There is deliberate efforts to enhance participation of women in macadamia farming, training of women in alternative ways of preparing macadamia nuts, and broadening efforts of export macadamia products.</li> <li>• Environmental conditions – Enhancing natural resource management</li> <li>• Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), infrastructure, and investment environment. The supporting frameworks/policies AFA, the Nuts and Oil Crops Directorate (NOCD), the Kenya Bureau of Standards and county governments, and KEPHIS</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Emerging business models will demand embracing production and marketing approaches that will enhance productivity and marketing opportunities. Total variable costs include technologies on; fertilizer/manure, Pesticides & fungicides, labour cost, transport and packaging materials. Assumption

	<p>production duration of 15 years, spacing of 7.5m by 7.5 m; costs were highest in year 1 of establishment and progressively reduced and stabilized at KES 14400 per acre. The distribution of average cost per acre by technologies is:</p> <ul style="list-style-type: none"> <li>• Cost of ploughing KES 4,000 (7.0 %)</li> <li>• Cost of harrowing KES 2,400 (4.2%)</li> <li>• Cost of preparing holes for planting KES 1,074 (1.9%)</li> <li>• Cost of Seedlings KES 28,640 (50.1%)</li> <li>• Cost seedlings planting/ replacement KES 1,290 (2.3%)</li> <li>• Cost of fertilizer NPK fertilizer KES 5,840 (10.2%)</li> <li>• Cost of manure KES 2,672 (4.7%)</li> <li>• Weeding KES 3,600 (6.3%)</li> <li>• Cost of staking KES 280 (0.5%)</li> <li>• Cost of irrigation (Watering) KES 2,820 (4.9%)</li> <li>• Cost of Chemicals for disease and pest control KES 2,400 (4.2%)</li> <li>• Cost of pruning KES 1,000 (1.7%)</li> <li>• Cost of harvesting and grading/packing KES 1,200 (2.1%)</li> </ul>
Estimated returns	<p>Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15.</p> <p><b>Revenue:</b> there was no revenue from year 1 to 3. Revenue inflow started in year 4 with KES 8,400 per acre and progressively rose to KES 640,800 per acre; The net present value (NPV) of macadamia was KES 1,129,441 per acre. Benefit cost ratio (<b>BCR</b>): Annual BCR rose from 1.00 in year 4 to 44 in year 15 with a pooled BCR was 11; the internal rate of return (<b>IRR</b>) was about 47%.</p>
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Development and dissemination – Different acceptance characteristics by youth, females and males. Gender roles in the production of macadamia. Availability of technologies for pre-harvesting, harvesting and post-harvesting</li> <li>• Adoption and scaling – Different acceptance characteristics, Gender inclusion in the formation of producer organizations. There is deliberate efforts to enhance participation of women in macadamia farming, training of women in alternative ways of preparing macadamia nuts, and</li> <li>• Access to production resources by youth, females and males</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Income generation opportunities by youth, females and males.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Development and dissemination – reduction in costs of production</li> <li>• Adoption and scaling up - Limited access to seed and information on new varieties and production techniques</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Income generation using farmer-market linking models</li> <li>• Access to inputs and markets through linkages and producer organization</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Farmers buy or acquire their seedlings in August and prefer grafted macadamia.</li> <li>• It takes four to five years for the tree to flower, and the flowering time usually happens between September and February. January is the growing period for macadamia nuts, and harvesting occurs from March to May. In June, when the harvest is over, farmers prune their trees</li> <li>• The price of macadamia has two main characteristics; it fluctuates a lot and it is high in relation to other cash crops</li> <li>• Farmers have turned to intercropping a variety of crops. Although farmers with a bigger size of land would prefer not to intercrop</li> <li>• Human capital through better training and education on how to care for the land and plants. This is where the agricultural officer who is currently positioned on the periphery can contribute</li> <li>• Financial capital is relatively weak seeing that despite the recent increase in price, the price volatility still prohibits a regular inflow of money, which would be necessary for a strong financial capital. Concentrating on improving the assets that are particularly weak, especially the human capital, should be a strategy to improve the farmers' livelihood</li> </ul>
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	The models are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Wanyama J.M.;
Lead organization and scientists	KALRO-FCRI– Kitale
Partner organizations	MoALF

## GAPS

- Challenges of implementing the agribusiness models

### *Further research*

1 Efficiency evaluation of the farmer-market linking models

2 Equity distribution among the producers

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

4 Farmer accessibility to production inputs

<b>2.10.2 TIMP Name</b>	<b>Developing a Business Plan for macadamia farm Business</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	

Problem addressed	Suboptimal management, low commercialization levels and lack of sustainability in macadamia farming business is attributed to lack of business plans.
What is it? (TIMP description)	A business plan can be developed at any segment of the value chain. A macadamia business plan is a management tool to successfully implement the business. It assists in determining resources required, how to obtain the resources and also successfully implement the macadamia business to meet the set objectives and goals.
Justification	With a business plan in hand, macadamia farmers and other actors along the value chain create a successful and sustainable business. Macadamia business plan will assist in improving chances of getting loans or grants and also manage business in difficult times
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Print media</li> <li>• FFBSs</li> <li>• Field days</li> <li>• Innovation platforms</li> <li>• Fact sheets</li> <li>• ICT</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Education levels of the farmers and other actors in macadamia value chain</li> <li>• Levels of experiences in macadamia production</li> <li>• Availability of information on macadamia production and marketing</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Users of business plans</li> <li>• County/National government extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders, exporters) – Buyers of macadamia</li> <li>• Research institutions – Capacity building</li> <li>• Financial Institutions – Financial support</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Bungoma, Muranga, Nyeri, Embu, Kirinyaga, Kiambu
Counties where TIMPs will be up scaled	Bungoma, Muranga, Nyeri, Embu, Kirinyaga, Kiambu, Meru and other potential macadamia growing areas
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Declining farm sizes</li> <li>• Low volumes of nuts produced</li> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on macadamia production and marketing</li> <li>• Levels of policy support</li> <li>• Low education levels</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>Declining farm sizes- Set minimum size for land subdivision for commercial agricultural production</li> <li>Low volumes of nuts produced-promote productivity enhance technologies, clustering of farmers</li> <li>Disorganization and scattered farmers – Formation of production clusters and aggregation centres</li> <li>Small-scale farming – aggregation of production to assume large scale-farming</li> <li>Inadequate information to stakeholders on the macadamia production – Embrace mobile telephony technology, Developing information hub</li> <li>Level of policy support – support in extension services</li> <li>Levels of education – Capacity building</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>Low adoption of business planning</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>Social conditions – Acceptable in Counties growing macadamia</li> <li>Environmental conditions – Availability of water resources</li> <li>Policy conditions – Policy support in opportunities selected</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>The estimated costs in the development of a business plan include a series of consultative meeting involving hiring of expertise. The inputs involved include stationary of about KES 5000</li> </ul>
Estimated returns	<p>Macadamia production has good returns. The business plan is expected to increase efficiency and profitability of the farm and macadamia agro-enterprises</p> <p><b>Revenue:</b> there was no revenue from year 1 to 3. Revenue inflow started in year 4 with KES 8,400 per acre and progressively rose to KES 640,800 per acre; The net present value (NPV) of macadamia was KES 1,129,441 per acre. Benefit cost ratio (<b>BCR</b>): Annual BCR rose from 1.00 in year 4 to 44 in year 15 with a pooled BCR was 11; the internal rate of return (<b>IRR</b>) was about 47%.</p>
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>High illiteracy levels of women leading to lack of record keeping and poor record keeping</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Being a high value crop, opportunities exist for youth since they are highly literate and can be able to keep good records</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Some are illiterate hence cannot keep good records</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>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.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous	None

similar projects	
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2. Requires validation, 3. Requires further research)	The matrices are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

## GAPS

- Embracing business plans is low

### *Further research*

5 Impact of business plan on macadamia production

6 Adoption of business plan

<b>2.10.3. TIMP Name</b>	<b>Implementing of Record keeping and Macadamia enterprise analysis</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low productivity and income
What is it? (TIMP description)	This involves putting the plan on the ground. Record keeping is the art of collecting useful pieces of data or information on the happenings of a particular undertaking, with the view of processing it in the future (for example, analysing sales and costs and calculating profits). Although record keeping is an important aspect of the family farm business, many farmers do not keep records. This makes it difficult for them to know how much they spent and how much income was earned from their farm business enterprises. Without good farm records, it becomes difficult for farmers to identify problem areas and know whether their businesses are generating profit or not. Therefore, record keeping is an important activity that is necessary for operating farm businesses successfully.
Justification	Proper Record keeping helps in assessing the performance of the Macadamia enterprise. There is need enhance and keep these records for assessing the growth of the enterprise.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents, policy makers
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Production programme</li> <li>• Availability of data on quantities of inputs requirements, costs, outputs and value</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Defining production programme</li> <li>• Processors</li> <li>• Traders</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Research</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	All 47 counties but at varying levels
Counties where TIMPs will be up scaled	<b>Meru County</b>
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the Macadamia production and marketing</li> <li>• Defining production programmes of Macadamia</li> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production clusters</li> <li>• Small-scale farming – allocation of more land to Macadamia production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the Macadamia production – Developing information hub</li> <li>• Defining production programmes of Macadamia</li> <li>• Level of policy support – support in extension services</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Majority of farmers do not keep records</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts with traditional Macadamia production</li> <li>• Environmental conditions – Opportunities with effects of degrading natural resource management</li> <li>• Policy conditions – Policy support in specific value chain segments</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	This will include buying books of accounts (Journal, Ledger, receipt books, invoice, cheque book, promisory notes, computer, printer, print papers, and other miscellaneous expenses) and labour required to record analyse the books of accounts. Cost of record keeping and analysis is then estimated at about KES 30000
Estimated returns	Macadamia production has good returns. Proper record keeping is likely to increase revenue and profits by about 10% or more
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• High illiteracy levels of women leading to lack of record keeping and poor record keeping</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to keep good records</li> </ul>

VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Some are illiterate hence cannot keep good records</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	Formats for record keeping, gross margin, break-even, Benefit-cost ratios are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Wanyama JM
Lead organization and scientists	KALRO FCRI Kitale
Partner organizations	MoALF

## GAPS

### *Further research*

- Profitable opportunities
- Performance of marketing as a group

<b>2.10.4 TIMP Name</b>	<b>Profitability analysis macadamia agro- enterprise</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Lack of records and investment analysis of the macadamia business performance by farmers and other upstream value chain actors. Subsequently, there is no comparative analysis over years, and among farmers and actors on the performance of the business
What is it? (TIMP description)	Investment analysis involves recording keeping and investment analysis using cost-benefit analysis returns. Since macadamia is a perennial crop discounted techniques in terms of annual gross margins, NPV, BCR and IRR will be generated
Justification	Investment analysis will inform farmers and other actors along the value chain on the success and sustainability of the business. It reveals adjustments one can make in the business to make it grow.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension, NGOs, Researchers, traders, processors and policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Trainings</li> <li>• Factsheets</li> </ul>

	<ul style="list-style-type: none"> <li>• Manuals</li> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Record keeping of costs and returns</li> <li>• Quality of records kept</li> <li>• Ability of farmers to keep records</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – record keeping</li> <li>• County extension staff - Facilitators</li> <li>• NGOs – Facilitators</li> <li>• Private sector (local traders and exporters) – Buyers</li> <li>• Research institutions – Facilitators</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	none
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Inability of farmers to keep records</li> <li>• Quality and types of records kept are suboptimal</li> <li>• Analytical skills by farmers and other actors are low</li> <li>• Use of non-cost family labour in macadamia production</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Inability of farmers to keep records – capacity building</li> <li>• Analytical skills by farmers and other actors are low- Train simple analysis skills</li> <li>• Use of non-cost family labour in macadamia production – capacity building on how to cost family labour</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Awareness on record keeping</li> <li>• Environmental conditions – There is potential to increase macadamia increased production of macadamia</li> <li>• Policy conditions – Policy support in costs of inputs and prices of outputs</li> <li>• Market conditions – Higher prices than costs</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<p>Total variable costs include technologies on; fertilizer/manure, Pesticides &amp; fungicides, labour cost, transport and packaging materials. Assumption production duration of 15 years, spacing of 7.5m by 7.5 m; costs were highest in year 1 of establishment and progressively reduced and stabilized at KES 14400 per acre. The distribution of average cost per acre by technologies is:</p> <ul style="list-style-type: none"> <li>• Cost of ploughing KES 4,000 (7.0 %)</li> </ul>

	<ul style="list-style-type: none"> <li>• Cost of harrowing KES 2,400 (4.2%)</li> <li>• Cost of preparing holes for planting KES 1,074 (1.9%)</li> <li>• Cost of Seedlings KES 28,640 (50.1%)</li> <li>• Cost seedlings planting/ replacement KES 1,290 (2.3%)</li> <li>• Cost of fertilizer NPK fertilizer KES 5,840 (10.2%)</li> <li>• Cost of manure KES 2,672 (4.7%)</li> <li>• Weeding KES 3,600 (6.3%)</li> <li>• Cost of staking KES 280 (0.5%)</li> <li>• Cost of irrigation (Watering) KES 2,820 (4.9%)</li> <li>• Cost of Chemicals for disease and pest control KES 2,400 (4.2%)</li> <li>• Cost of pruning KES 1,000 (1.7%)</li> <li>• Cost of harvesting and grading/packing KES 1,200 (2.1%)</li> </ul>
Estimated returns	<p>Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15. <b>Revenue:</b> there was no revenue from year 1 to 3. Revenue inflow started in year 4 with KES 8,400 per acre and progressively rose to KES 640,800 per acre; The net present value (NPV) of macadamia was KES 1,129,441 per acre. Benefit cost ratio (<b>BCR</b>): Annual BCR rose from 1.00 in year 4 to 44 in year 15 with a pooled BCR was 11; the internal rate of return (<b>IRR</b>) was about 47%.</p>
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• High illiteracy levels of women leading to lack of record keeping and poor record keeping</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to keep good records</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Some are illiterate hence cannot keep good records</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.

Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

#### GAPS

- Monitoring volatile input and output prices to update the economic and financial indicators
- Declining soil fertility and its implication on out prices and revenue

#### *Further research*

- Investigation on strategies to reduce costs of production of macadamia
- How to promote of domestic consumption of macadamia products
- Assessing volatility in price and how to smoothen

<b>2.10.5 TIMP Name</b>	<b>Scaling up and scaling out plan of macadamia agro-enterprise</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	There is a package of macadamia technologies to be promoted and also there could macadamia innovations from farmers not identified that can be validated and promoted. However, there is limited uptake of macadamia the technologies by farmers and other stakeholders upstream of the value chain. There is need to identify scaling strategies for macadamia technologies and also partner with other organizations for effective promotion. There is need for producer groups and other actors along the value chain to upgrade the value chain. Increasing production from increasing size of existing group,
What is it? (TIMP description)	A new plan to organize farmers to supply target markets. This is a plan to increase production to add new groups. The plan involves managing more groups, training other facilitators, working with second-order associations and cooperatives, working with buyers, promoting innovation and communication and the media
Justification	Effective promotion may demand that farmers and other upstream actors are in groups or associations. Associations may have more bargaining power for input and output markets for macadamia products. They may also share experiences and benefits in macadamia agro-enterprise.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Traders</li> <li>• Processors</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Trainings</li> <li>• Factsheets</li> <li>• Manuals</li> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Field days</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• What is the sustainability of groups</li> <li>• Do we have political will</li> <li>• Do we have institutions willing to support the change</li> <li>• Do we have financial support to facilitate promotion</li> <li>• Can the farmers and other actors increase volumes of products generated</li> <li>• How will the farmers increase their production and sales (more technology, more land, more members)</li> <li>• Can the farmers work with other existing groups (available/not available)</li> <li>• Do the farmers need to form new groups</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Members of producer organization</li> <li>• Processors-value addition for higher prices</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Targeted markets</li> <li>• Research institutions – Capacity building</li> <li>• Regulatory institutions-Regulate and control value chain</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Meru county
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• There is macadamia high transaction costs,</li> <li>• Exclusion from high value markets,</li> <li>• information asymmetry and</li> <li>• non-enforcement of marketing contracts</li> <li>• Sustainability of the groups</li> <li>• Issues related to increasing production from existing group</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• There is macadamia high transaction costs-aggregation</li> <li>• Exclusion from high value markets-partnering and favorable policy environment</li> <li>• information asymmetry and</li> <li>• non-enforcement of marketing contracts-Have legally binding contracts</li> <li>• Sustainability of the groups-integrate sustainability issues</li> <li>• Issues related to increasing production from existing group – farmers reach their new production target from the group members and farmers investing in new technology to achieve new targets</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – are there other farmers who want to join the group, do we have new groups and membership?</li> <li>• Environmental conditions – would the increase in production come from improved technology, more land, or new members in the group</li> <li>• Policy conditions – Policies supporting formation and functioning of producer organizations</li> <li>• Market conditions – new markets</li> <li>• Cost of scaling up macadamia technologies??</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The estimated cost per farmer of different upscaling methods include; pathways are Open days (KES 10), field days (KES 281), print media (KES 462), demonstrations (KES 772), Agricultural shows (KES 834), Community resource persons (KES 988), Extension visits KES 1,084), and farm exchange visit (KES 13,172).
Estimated returns	Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15. <b>Revenue:</b> Since the production of macadamia is likely to increase by about 20% annually, then the revenue may also increase by the same margin.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women are widely discriminated in agro-enterprise groups</li> <li>• Women also have limited participation and influence in agro-enterprise groups</li> <li>• Limited access to assets, resources and services, required to join agro-enterprise groups</li> <li>• In some cultures women may not be able to travel away from their homes to agro-enterprise groups, without permission</li> <li>• Strict rules of entry and requirements of agro-enterprise groups' may limit women participation</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Men and youth stand to benefit with higher profit margins through collective bargaining during marketing</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs are widely discriminated in agro-enterprise groups</li> <li>• VMGs also have limited participation and influence in agro-enterprise groups</li> <li>• Limited access to assets, resources and services, required to join agro-enterprise groups</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• VMGs stand to benefit with higher profit margins through collective bargaining and marketing</li> <li>• Opportunities exist for unemployed youth in</li> </ul>

	production and marketing through ICT
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training materials: factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling,
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

## GAPS

### *Further research*

7 Processes in scaling up agro-enterprise development approach and production

8 Effects of scaling up plan

<b>2.10.6 TIMP Name</b>	<b>Marketing as a group/Collective marketing (producer organization) as a marketing strategy</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Lack of bargaining power and volumes for sale of macadamia nuts and derived products
What is it? (TIMP description)	This involves farmers or actors in a given group or location who engage in production of macadamia products and sell as a group. This involves farmers or other actors down- or upstream the value chain, who form groups. The groups enables them have good volumes of products; have common transport, storage, reach market, bargain as a group; acquire inputs as a group and they can also access government benefits as a group
Justification	Low resource base farmers and other actors along the value chain inaccessible areas do not fully understand how the macadamia market works or why prices fluctuate; they have limited or no information on market conditions, prices and quality of macadamia products; they are not organized collectively; and they have no experience of market negotiation and little appreciation of their capacity to influence the terms and conditions upon which they enter the market. Difficult market access restricts opportunities for income generation. Farmer organization provides relevant data to help solve marketing challenges.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension, NGOs, Researchers. Processors,

	traders
Approaches to be used in dissemination	Barazas, Trainings, Factsheets, Manuals, Field days, ICT, Radio
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Organization of farmers</li> <li>• Availability of facilitators</li> <li>• Availability of many traders</li> <li>• Production volume and quality</li> <li>• Trust</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Organization of groups</li> <li>• County extension staff - Facilitators</li> <li>• NGOs – Facilitators</li> <li>• Private sector (local traders and exporters) – Buyers</li> <li>• Research institutions – Facilitators</li> <li>• County government – Policy support</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Meru county</b>
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Individually produce small volumes</li> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Availability of information</li> <li>• Levels of policy support</li> <li>• Poor management</li> <li>• Political interference</li> <li>• Corruption</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Individually produce small volumes- Have apex associations at county level</li> <li>• Disorganization and scattered farmers – Formation of producer organization</li> <li>• Small-scale farming – allocation of more land to Macadamia production and aggregation of production to assume large scale-farming, improved productivity</li> <li>• Availability of information – Capacity building of producer groups</li> <li>• Policy support-Engagement with the county government</li> <li>• Poor management-Train on project management</li> <li>• Political interference- Politicians to keep off</li> <li>• Corruption-High penalties, training, embrace integrity, close monitoring</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Reduction of transaction costs leading to increased profits</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Producer group by-laws to govern the operations, Groups to be business oriented</li> <li>• Environmental conditions – Depleted soil nutrients due over-use of cultivated land and pollution due to use of pesticides</li> </ul>

	<ul style="list-style-type: none"> <li>• Policy conditions – Available policy support</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<p>Total variable costs include technologies on; fertilizer/manure, Pesticides &amp; fungicides, labour cost, transport and packaging materials. Assumption production duration of 15 years, spacing of 7.5m by 7.5 m; costs were highest in year 1 of establishment and progressively reduced and stabilized at KES 14400 per acre. The distribution of average cost per acre by technologies is:</p> <ul style="list-style-type: none"> <li>• Cost of ploughing KES 4,000 (7.0 %)</li> <li>• Cost of harrowing KES 2,400 (4.2%)</li> <li>• Cost of preparing holes for planting KES 1,074 (1.9%)</li> <li>• Cost of Seedlings KES 28,640 (50.1%)</li> <li>• Cost seedlings planting/ replacement KES 1,290 (2.3%)</li> <li>• Cost of fertilizer NPK fertilizer KES 5,840 (10.2%)</li> <li>• Cost of manure KES 2,672 (4.7%)</li> <li>• Weeding KES 3,600 (6.3%)</li> <li>• Cost of staking KES 280 (0.5%)</li> <li>• Cost of irrigation (Watering) KES 2,820 (4.9%)</li> <li>• Cost of Chemicals for disease and pest control KES 2,400 (4.2%)</li> <li>• Cost of pruning KES 1,000 (1.7%)</li> <li>• Cost of harvesting and grading/packing KES 1,200 (2.1%)</li> <li>• Cost of collective marketing?????</li> </ul>
Estimated returns	<p>Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15. <b>Revenue:</b> there was no revenue from year 1 to 3. Revenue inflow started in year 4 with KES 8,400 per acre and progressively rose to KES 640,800 per acre; The net present value (NPV) of macadamia was KES 1,129,441 per acre. Benefit cost ratio (<b>BCR</b>): Annual BCR rose from 1.00 in year 4 to 44 in year 15 with a pooled BCR was 11; the internal rate of return (<b>IRR</b>) was about 47%.</p>
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women are widely discriminated in rural producer organizations</li> <li>• Women also have limited participation and influence in rural producer organizations</li> <li>• Socio-cultural norms may limit women's participation and leadership in groups</li> <li>• Women's double and triple roles means they may not have time to participate</li> <li>• Women's status, age, wealth level may influence participation</li> <li>• Limited access to assets, resources and services,</li> </ul>

	<p>required to join producer groups</p> <ul style="list-style-type: none"> <li>• In some cultures women may not be able to travel away from their homes to producer group meetings, without permission</li> <li>• Strict rules of entry and requirements of producers' organizations may limit women participation</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Men and youth stand to benefit with higher profit margins through collective bargaining during marketing</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs are widely discriminated in rural producer organizations</li> <li>• VMGs also have limited participation and influence in rural producer organizations</li> <li>• Limited access to assets, resources and services, required to join producer groups</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• VMGs stand to benefit with higher profit margins through collective bargaining and marketing</li> <li>• Opportunities exist for unemployed youth in production and marketing through ICT</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training materials: factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	Marketing as a group guidelines are ready for use if provided
<b>G: Contacts</b>	
Contacts	Wanyama JM
Lead organization and scientists	KALRO FCRI-Kitale
Partner organizations	MoALF

### Gaps for further research

- Suboptimal performance of marketing organization
- Sustainability of the management of the organization
- Equity distribution in sales and income

<b>2.10.7. TIMP Name</b>	<b>Participatory market research</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Farmers and other actors along the value chain lack of alternative market information on outlets of Macadamia
What is it? (TIMP description)	Pathways and sources through which by farmers and other

	actors along the macadamia value chain to access market information
Justification	The low resource base farmers and other actors are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power they require to interact on equal terms with other, generally larger and stronger, market intermediaries. Cultural and social distance, and discrimination, may also be factors that at least partly exclude the poor from markets. Therefore participatory market research will assist farmer to gain knowledge on the structure and performance of markets leading to higher profit.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, extension, research institutions
Approaches to be used in dissemination	<i>Barazas</i> , trainings, factsheets, manuals, media, ICT, Field days,
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of County policies</li> <li>• Willingness of farmers</li> <li>• Availability of targeted markets</li> <li>• Access to markets</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – participants in market research</li> <li>• Processors- capacity built</li> <li>• Traders-capacity built</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Targeted markets</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	
Counties where TIMPs will be up scaled	Meru county
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Insufficient stakeholder collaboration: communication and dialogue among macadamia stakeholders is lacking. Often, conflicting interests among actors lead to attitudes of rivalry.</li> <li>• Poor EU market access: although some processors have links to European markets, the notion prevails among EU buyers that Kenyan macadamia is of inferior quality</li> <li>• Traceability: upstream traceability of Kenyan macadamia is severely challenged by the large number of smallholder farmers and independent buying agents.</li> <li>• Low productivity: factors affecting low productivity in Kenya’s macadamia sector include the effects of climate change, the impact of pests and diseases, poor Good Agricultural Practices (GAP), lack of access to inputs, use of unsuitable or old macadamia varieties and immature harvesting</li> </ul>

	<ul style="list-style-type: none"> <li>• Inadequate information on the Macadamia and macadamia-by-products market outlets.</li> <li>• Lack of skills in the use of communication technologies</li> <li>• Group dynamics</li> <li>• Policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Insufficient stakeholder collaboration-Dialogue and transparency should be the ruling principles of this code of conduct.</li> <li>• Poor EU market access- creation and marketing of a Kenyan macadamia brand should be explored</li> <li>• Low-quality nuts- solution is to support processors who wish to obtain loans to buy crops in advance, thereby addressing farmer’ need for quick cash. In addition need to implement relevant harvesting plans in advance. Give grace period of non-harvesting</li> <li>• Disorganization and scattered farmers – Organization of producer groups for cooperate marketing.</li> <li>• Small-scale farming – Increase hectarage under Macadamia production, improving productivity and aggregation of produce to achieve large volume for the market</li> <li>• Inadequate information to stakeholders on the Macadamia production and marketing – Capacity building on sources of information.</li> <li>• Group dynamics – Capacity building</li> <li>• Policy support – Support in extension services</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Improved marketing strategies</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Level of education of the community</li> <li>• Environmental conditions – Farmers are in different geographical localities</li> <li>• Policy conditions – Policies supporting formation and functioning of producer organizations</li> <li>• Market conditions – Existing demand</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The inputs required may include stationary, smart phone, note books ad airtime and probably annual subscription to some websites to gent market information on macadamia. Cost of participatory marketing research is estimated at KES 1000 month resulting in KES 12000 annually
Estimated returns	Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15. <b>Revenue:</b> The estimated selling price and revenue of Macadamia may increase by 20%.
Gender issues and concerns in development and dissemination,	<ul style="list-style-type: none"> <li>• Inadequate representation of women and youth</li> </ul>

adoption and scaling	the participatory market research
Gender related opportunities	<ul style="list-style-type: none"> <li>Women and youth have an opportunity to participate in participatory market research if they are willing</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs also have limited participation in participatory market research</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities for those recovering from drugs and HIV to participate in participatory market research</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Barazas, training factsheets, manuals and power point slides
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	The guidelines for the participatory market research are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Wanyama JM
Lead organization and scientists	KALRO FCRI Kitale
Partner organizations	MoALF

#### Gaps for further research

- 1 Performance of participatory market research process
- 2 Production and marketing efficiency in macadamia due to the participatory market research process
- 3 Equity distribution in income and change in livelihood

<b>2.10.8. TIMP Name</b>	<b>Contract farming as a marketing strategy</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Markets failure in Macadamia production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves private companies extending credit to producers and other actors in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.
Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract

	farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, extension, research institutions, farmer cooperative societies
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Willing farmers</li> <li>• Availability of traders</li> <li>• Competitiveness of Macadamia</li> <li>• Production volume</li> <li>• Enforcement and bidding contract farming</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Contract party and beneficiaries</li> <li>• County extension staff - Capacity building, signing contract</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Contract party and beneficiaries</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Meru county</b>
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Lack of information by part of the producers</li> <li>• Level of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production clusters</li> <li>• Small-scale farming – Increase volume through increase in productivity</li> <li>• Lack of information by part of the producers – Capacity building</li> <li>• Level of policy support – County policy formulation and enforcement for contract farming</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Increased benefits</li> </ul>

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions -Conflicts with traditional farming</li> <li>• Environmental conditions-reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management</li> <li>• Policy conditions-Policy in formulation and enforcement</li> <li>• Market conditions-volume, place, price, promotion, traders</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<p>Total variable costs include technologies on; fertilizer/manure, Pesticides &amp; fungicides, labour cost, transport and packaging materials. Assumption production duration of 15 years, spacing of 7.5m by 7.5 m;</p> <ul style="list-style-type: none"> <li>• Average costs of producing one kg of macadamia is about KES 7 and average selling price is about KES 150 per kg</li> <li>• Cost of Contract farming runs to as high as US\$ 200,000 annually in a group of 5-200 members</li> </ul>
Estimated returns	<p>Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15. <b>Revenue:</b> The average annual revenue is about KES 823,125. The average revenue per kg is about KES 150.</p>
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women have less access to knowledge and information on contract farming than men</li> <li>• Women have less access to land for farming than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to knowledge and information on contract farming than men</li> <li>• VMGs have less access to land for farming than men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires	The guidelines for the contract farming are ready for up-scaling

further research)	
<b>G: Contacts</b>	
Contacts	Wanyama JM
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

### Gaps for further research

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

<b>2.10.9. TIMP Name</b>	<b>E-marketing of macadamia products: Internet/online/mobile marketing</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	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 mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Education levels of the farmers and investors in Macadamia production and profitability analysis</li> <li>• Levels of experiences in Macadamia production</li> <li>• Availability of information on Macadamia production and marketing</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Sellers of Macadamia production</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Buyers of macadamia</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be	Meru county

up scaled	
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Low digital skills of farmers</li> <li>• Unconsolidated produce for the market</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the Macadamia production and marketing and profitability</li> <li>• Internet connectivity</li> <li>• Levels of policy support on internet infrastructure</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Low digital skills of farmers – capacity building</li> <li>• Unconsolidated produce for the market – Delivery of produce to the designated centres</li> <li>• Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce</li> <li>• Inadequate information to stakeholders on the Macadamia production and marketing and profitability - Developing information hubs</li> <li>• Internet connectivity – Information hubs</li> <li>• Level of policy support – Policy support in internet infrastructure and utilization</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Requires stakeholders involvement</li> <li>• Remains the best cost effective option for marketing in terms of searching for the market information</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions - low levels of adoption of information technology</li> <li>• Environmental conditions-improved internet connectivity</li> <li>• Policy conditions - Policy supporting information hubs</li> <li>• Market conditions-high costs of information technologies</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• The E-marketing requires investments in ICT tools and equipment. These may include smart phones, computer and printer including annual subscription to access some market information or strategies in selling macadamia products and also buying inputs.</li> <li>• Annual estimated costs of E-marketing at about KES 10000</li> </ul>
Estimated returns	It is assumed that the sales of ,academia products will increase by about 20% and the inputs may decrease by 10%
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women have less access to the required tools such as phones and computer than men</li> <li>• Women are more illiterate and therefore cannot use the ICTs compared with men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have the phones or the computer</li> </ul>

VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to the required tools such as phones and computer than men</li> <li>• VMGs are more illiterate and therefore cannot use the ICTs compared with men</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have the phones or the computer</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	The platforms are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Wanyama JM
Lead organization and scientists	KALRO-FCRI- Kitale
Partner organizations	MoALF

### Gaps for further research

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

## 2.12 Agricultural Policy Options

<b>2.11.1. TIMP Name</b>	<b>Regional and National Agricultural policy framework and strategies supporting Macadamia agro-enterprise</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The macadamia value chain is short with primary level dominated by smallholder farmers. The other actors are producer groups, brokers and processors including foreign wholesalers and retailers. There is no macadamia policy directly supporting macadamia producers. The crop is regulated under the National Oil and Nuts regulations. We have policies and regulation embed in other The current policy is not sufficient and no new policy is in the process being developed. It take too long formulate the policy. This calls for the need to review current regional, national and county government regulations influencing macadamia agro-enterprise. For example macadamia market may be governed by rules and regulations that are mostly informal and not rooted in law. This affects livelihoods of many famers and

	citizens that dependent on the crop
What is it? (TIMP description)	Regional, National Agricultural policy framework includes policies, regulations and laws that control and regulate macadamia business that is dominated by small-scale producers.
Justification	Agricultural policy instruments, and regulations affect macadamia value chain actors differently. This calls for the need to review and educate farmers and other stakeholders on the current policies, regulations and laws that affect their macadamia business. Agricultural policy making in Kenya is long. Some of the policies are conflicting and do not meet the indented policy objectives and goals. Therefore the need to review and propose adjustments of the same for increased macadamia productivity and positive effects to the value chain actors.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Policy makers</li> <li>• Traders-wholesalers, retailers, importers, exporters</li> <li>• Processing industries</li> <li>• Extension</li> <li>• NGOs</li> <li>• Research institutions</li> <li>• Regulatory institutions</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings including policy advocates</li> <li>• Radio</li> <li>• Television</li> <li>• Social media (WhatsApp, Facebook, twitter)</li> <li>• Internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Positive response of macadamia stakeholders</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Demanding Macadamia policies to support production and marketing</li> <li>• Processors- demand favorable policies</li> <li>• Traders (Exporters, wholesalers and retailers)-demand favorable policies</li> <li>• National and County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> <li>• Private sector (wholesalers, retailers and exporters) – Demanding Macadamia policies to support production and marketing</li> <li>• Research institutions – Sensitization of stakeholders</li> </ul>

	<ul style="list-style-type: none"> <li>• Policy makers – Assist in policy making</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Meru county
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• <b>Value Chain:</b> Macadamia yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials.</li> <li>• <b>Consumption-</b> Low domestic consumption</li> <li>• <b>Standards:</b> International quality standards are high. No certification in some segments of macadamia value chain.</li> <li>• <b>Aggregation:</b> Aggregation of macadamia centres are not well regulated and contracts are not fully adhered to. These weak organizations provide few services to farmers while providing limited bargaining power.</li> <li>• <b>Financial Incentives:</b> Financial support is concentrated to to upstream value chain actors like exporters but primary producers are not fully covered and if covered the costs are high.</li> </ul>
Suggestions for addressing the challenges	<p><b>Value Chain:</b> Increase yields and production through training on GAP (eg better seeds, irrigation, and CSA management practices including post-harvest). Develop targeted incentives to encourage stronger engagement of producers by both upstream and downstream actors.</p> <p><b>Standards:</b> Existing Macadamia standards could be harmonized with regional and international ones. Train farmers on quality standards</p> <p><b>Aggregation:</b> Partnerships between farmer cooperatives and Macadamia producers and other upstream value chain actors can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs.</p> <p><b>Financial Incentives:</b> Financial incentives can be given to macadamia primary producers and other actors who are constrained with investment funds.</p>
Lessons learned in upscaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – The number and acreage under macadamia is increasing and also the number of actors is on the rise</li> <li>• Environmental conditions –The the crop is faced with pests and diseases use of pesticides should be properly done. Organically produced nuts can have a special market niche and fetch higher prices</li> <li>• Policy conditions – Lacking specific Macadamia policy</li> <li>• Market conditions - Poor market infrastructure</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• These review may require a series of consultative meeting and reporting of stakeholders in macadamia value chain.</li> <li>• Estimated costs of policy review costs are about KES 20000</li> </ul>
Estimated returns	The returns may include favourable production and marketing of macadamia which may increase by 5-10%
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Enabling environment for the VMGs in the production and marketing of Macadamia for increased incomes and employment creation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	Some Requires validation and upscaling
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALDF

### **Gaps for further research**

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

<b>2.11.2 TIMP Name</b>	<b>Policy options influencing Macadamia producers and other value chain actors</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	There are diverse policy options influencing production, processing and marketing of macadamia nuts and derived products and services. Some of the policies are conflicting. This leads to market failure which negatively influences upgrading of macadamia value chain
What is it? (TIMP description)	There are policies, strategies, and regulations that govern the macadamia value chain. Policies have instruments and rules with specific objectives to be attained. These affects macadamia producers, input suppliers (eg fertilizer nursery operators) differently. The effects can be positive or negative. This calls for the need to review and inform farmers and other actors including policy makers on the effects.
Justification	Agricultural policies for supporting Macadamia output are based at farm, processing marketing levels including exports. The policy objective is to increase upgrade Macadamia value chain by increasing production and having quality products for he consumers. The policy instruments chosen might be raise the price of Macadamia received by producers, such as an import tax or a production subsidy, an instrument to reduce the cost of grain production such as an input subsidy or capital grant and an instrument which reduces returns to products which compete Macadamia for land, thus causing substitution of resources into Macadamia production.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Traders (exporters, wholesalers and retailers)</li> <li>• Processing industries</li> <li>• Extension</li> <li>• NGOs</li> <li>• Research institutions</li> <li>• Policy makers</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings</li> <li>• Radio</li> <li>• Television</li> <li>• Social media (WhatsApp, Facebook, twitter), internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools(FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>
Critical/essential factors for	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> </ul>

successful promotion	<ul style="list-style-type: none"> <li>• Availability of agricultural policies and specific Macadamia-based policies</li> <li>• Issues in Macadamia business along value chain</li> <li>• Specific policy objective statement</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Demanding Macadamia policies to support production and marketing</li> <li>• County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> <li>• Private sector (local traders and exporters) – Demanding Macadamia policies to support production and marketing</li> <li>• Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Meru
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Poor aggregation models</li> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>• Poorly established Macadamia value chain</li> <li>• Macadamia production are specific to agro-ecological zones and not all the Counties in Kenya grow Macadamia</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Poor aggregation models-favorable polies for aggregators</li> <li>• Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>• Small-scale farming – Policies for increasing productivity</li> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>• Poorly established Macadamia value chain – strengthening Macadamia value chain</li> <li>• Macadamia production are specific to agro-ecological zones and not all the Counties in Kenya grow Macadamia – Diversification of Macadamia</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Acceptability of the policies</li> <li>• Environmental conditions – lack of a comprehensive land use policy</li> <li>• Policy conditions – Lacking specific Macadamia</li> </ul>

	<p>policy</p> <ul style="list-style-type: none"> <li>• Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<p>The policy options are geared towards reducing the following costs of production levels per acre:</p> <ul style="list-style-type: none"> <li>• Cost of ploughing KES 4,000 (7.0 %)</li> <li>• Cost of harrowing KES 2,400 (4.2%)</li> <li>• Cost of preparing holes for planting KES 1,074 (1.9%)</li> <li>• Cost of Seedlings KES 28,640 (50.1%)</li> <li>• Cost seedlings planting/ replacement KES 1,290 (2.3%)</li> <li>• Cost of fertilizer NPK fertilizer KES 5,840 (10.2%)</li> <li>• Cost of manure KES 2,672 (4.7%)</li> <li>• Weeding KES 3,600 (6.3%)</li> <li>• Cost of staking KES 280 (0.5%)</li> <li>• Cost of irrigation (Watering) KES 2,820 (4.9%)</li> <li>• Cost of Chemicals for disease and pest control KES 2,400 (4.2%)</li> <li>• Cost of pruning KES 1,000 (1.7%)</li> <li>• Cost of harvesting and grading/packing KES 1,200 (2.1%)</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Policy options aim at having high Macadamia production with good returns. The yield levels should increase from the current level by about 5-10%</li> </ul>
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2,	Requires validation

Requires validation, 3. Requires further research)	
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALDF

## GAPS

Unfavorable policy options

### *Further research*

9 Adoption of policy options

10 Equity distribution among the stakeholders

11 Productivity levels among the smallholder farmers

12 Farmer accessibility to production inputs

<b>2.11.3 TIMP Name</b>	<b>Policy Instruments influencing Macadamia value chain</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Failure to achieve policy objectives due to unfavorable instruments and regulations. Poor administration or lack of implementation of policy instruments affects macadamia producers and other actors along the value chain unfavourably
What is it? (TIMP description)	Policy instruments are the means to achieve policy objectives.
Justification	There are strategies, techniques and methods used by the government to achieve policy objectives and goals. Policy instruments may result in desired or unfavorable results. this may require adjustments or reviewing of the policies.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Community advocacy groups</li> <li>• Traders</li> <li>• Processing industries</li> <li>• Extension</li> <li>• NGOs</li> <li>• Research institutions</li> <li>• Policy makers</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings</li> <li>• Radio</li> <li>• Television</li> <li>• Social media (What's App, Facebook, twitter)</li> <li>• Internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of policy objectives</li> <li>• Availability of policy instruments</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – beneficiaries of policy instruments</li> <li>• County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> <li>• Private sector (local traders and exporters) – beneficiaries</li> <li>• Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Meru County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>• Poorly established Macadamia value chain</li> <li>• Macadamia production are specific to agro-ecological zones and not all the Counties in Kenya grow Macadamia</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>• Small-scale farming – Policies for increasing productivity</li> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>• Poorly established Macadamia value chain – strengthening Macadamia value chain</li> <li>• Macadamia production are specific to agro-ecological zones and not all the Counties in Kenya grow Macadamia – Diversification of Macadamia</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Low understanding of policy instruments</li> <li>• Environmental conditions – lack of a comprehensive land use policy</li> <li>• Policy conditions – Lacking specific Macadamia policy</li> <li>• Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• The cost elements include Literature review , stationary, among others</li> <li>• Review costs is estimated at KES 50,000</li> </ul>
Estimated returns	Macadamia production has good returns. <b>Revenue:</b> there was no revenue from year 1 to 3. Revenue

	inflow started in year 4 with KES 8,400 per acre and progressively rose to KES 640,800 per acre; The net present value (NPV) of macadamia was KES 1,129,441 per acre.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2. Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

## GAPS

There are conflicting policy instruments

Non-implementation of some policy instruments

### **Further research**

- 13 Validation of policy instruments
- 14 Equity distribution among the stakeholders
- 15 Farmer accessibility to production inputs markets
- 16 Farmers accessibility to output markets

<b>2.11.4 TIMP Name</b>	<b>Policy cycle and implementation at county level of macadamia value chain</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Why is a policy cycle an appropriate tool for making policies

	related to Macadamia? Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. These individual steps provides a frame work and antedates any forthcoming issues related to policy development
What is it? (TIMP description)	The policy cycle is usually divided into five stages: agenda setting, formulation, implementation, and evaluation
Justification	The policy cycle creates the need for a policy based on the agricultural problem emergence/issues. The policy cycle is an idealized process that explains how policy should be drafted, implemented and assessed. It serves more as an instructive guide for those new to policy than as a practical strictly-defined process, but many organizations aim to complete policies using the policy cycle as an optimal model. Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. ... These steps are flexible enough to incorporate any changes at the time of new policy development and as a part of continuous change once it is implemented.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers</li> <li>• Traders</li> <li>• Processing industries</li> <li>• Extension</li> <li>• NGOs</li> <li>• Research institutions</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings</li> <li>• Radio</li> <li>• Television</li> <li>• Social media (What's App, Facebook, twitter)</li> <li>• Internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• The stages of problem emergence, formulation, implementation and evaluation</li> <li>• Applied and adaptive Research to test, validate and release improved macadamia varieties</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – generate issues</li> <li>• County extension staff - capacity building</li> <li>• NGOs – capacity building</li> <li>• Private sector (local traders and exporters) – generate issues</li> <li>• Research institutions – capacity building</li> <li>• Policy makers</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Meru
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on issues</li> <li>• Poorly established Macadamia value chain</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – issues on formation of producer organizations as an institution</li> <li>• Small-scale farming – issues on aggregation</li> <li>• Inadequate information to stakeholders – Sensitization on the roles of each policy cycle stages</li> <li>• Poorly established Macadamia value chain – strengthening Macadamia value chain</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Different issues among the Macadamia producers</li> <li>• Environmental conditions – environmental issues</li> <li>• Policy conditions – Lacking specific Macadamia policy</li> <li>• Market conditions – Market issues</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Total variable costs include; consultative meetings, and KII., stationery, stationery The estimated costs Cost of policy implementation. KES 30000.
Estimated returns	Macadamia production has good returns. <b>Assumptions:</b> Interest rate of 12%; farm gate price of 150 per kg.; <b>Yield:</b> there was no production during the first three years. In year 4 the yield was about 58 kg per acre and progressively rose to 7872 kg per acre in year 15. <b>Revenue:</b> there was no revenue from year 1 to 3. Revenue inflow started in year 4 with KES 8,400 per acre and progressively rose to KES 640,800 per acre; The net present value (NPV) of macadamia was KES 1,129,441 per acre. Benefit cost ratio ( <b>BCR</b> ): Annual BCR rose from 1.00 in year 4 to 44 in year 15 with a pooled BCR was 11; the internal rate of return ( <b>IRR</b> ) was about 47%.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well</li> </ul>
VMG issues and concerns in development and dissemination,	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in</li> </ul>

adoption and scaling up	<p>policy development forums at all levels</p> <ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2. Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

## GAPS

Low integration of policy at county level

### *Further research*

Integration macadamia policy at county levels

Impact on the new policy on Macadamia production and marketing

<b>2.11.5 TIMP Name</b>	<b>Policy validation customization for macadamia value chain</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High costs in making a new and emerging policies relevant to Macadamia production and marketing. Conflicting policy instruments in macadamia value chain activities.
What is it? (TIMP description)	A policy validation cycle involves an existing agricultural policy, database and stakeholders.
Justification	To reduce costs in developing a new policy, policy validation cycle is useful.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, traders</li> <li>• Importers and exporters</li> <li>• Processing industries</li> <li>• Extension</li> <li>• NGOs</li> <li>• Research institutions</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Meetings</li> <li>• Radio</li> <li>• Television</li> </ul>

	<ul style="list-style-type: none"> <li>• Social media (What's App, Facebook, twitter)</li> <li>• Internet</li> <li>• Farmers' groups</li> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• Availability and knowledge of agricultural policies</li> <li>• Certification of products along the value chain</li> <li>• A platform for interaction in macadamia value chain stakeholders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – provide database</li> <li>• County extension staff - data collection</li> <li>• NGOs – provide data</li> <li>• Private sector (local traders and exporters) – provide data</li> <li>• Research institutions – analysis and recommendations</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Meru county
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Poorly established Macadamia value chain</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – information on application of the policy</li> <li>• Small-scale farming – information on production levels</li> <li>• Poorly established Macadamia value chain – strengthening Macadamia value chain</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – lack of information</li> <li>• Environmental conditions – lack of a comprehensive land use policy</li> <li>• Policy conditions – Lacking specific Macadamia policy</li> <li>• Market conditions – lack of information</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• The inputs required for validation include consultative meetings, Key informant interviews, stationery:</li> <li>• Policy validation cost is about KES 50,000</li> </ul>
Estimated returns	<b>Revenue:</b> Favourable policies that will increase productivity and price by at least 5%
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels</li> <li>• Inadequate representation of youth and women in the policy of validation process</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frame to support their participation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for upscaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Wanyama, J.M.
Lead organization and scientists	KALRO-FCRI-Kitale
Partner organizations	MoALF

#### **GAPS**

- Low implementation of developed polices
- Negative impacts of policies on the farming communities

#### ***Further research***

#### References

Impact of validated policies (Nyongesa D., 2021)



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