

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



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DISCLAIMER

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

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FOREWORD

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

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

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

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

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

PREFACE

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

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

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

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

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

Samuel Guto, PhD

National Project Coordinator

National Agricultural Value Chain Development Project

ABBREVIATIONS AND ACRONYMS

°C	Degrees Centigrade
A.S.K	Agricultural Society of Kenya
AFA	Agriculture and Food Authority
AIPs	Agricultural innovation Platforms
AMRI	Agricultural Mechanization Research Institute
ATDC	Agricultural Technology Development Centre
CABI	Centre for Agriculture and Bioscience International
CAN	Calcium Ammonium Nitrate
CBO	Community Based Organisation
CIDP	County Integrated Development Plan
CIGs	Common Interest Groups
CSA	Climate Smart Agriculture
FAO	Food and Agriculture Organization
FFBS	Farmer Field and Business Schools
FFS	Farmer Field Schools
FPO	Farmer Producer Organization
FPO	Producer Organization
FYM	Farm Yard Manure
GAPs	Good Agricultural Practices
GHGs	Greenhouse Gases
HACCP	Hazard Analysis Critical Control Points
ICIPE	Integrated Centre for Insect Physiology and Ecology
ICRAF	International Center for Agro-Forestry Research
ICTs	Information Communication Technologies
ILRI	International Livestock Research Institute
IPM	Integrated Pest Management
IPR	Intellectual Property Rights
IWM	Integrated Weed Management
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KCSAP	Kenya Climate-Smart Agriculture Project
KEBs	Kenya Bureau of Standards
KEFRI	Kenya Forestry Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KES	Kenya Shillings
KIRDI	Kenya Industrial Research Institute
KPGA	Pyrethrum growers association
KES	Kenya Shillings
MoALD	Ministry of Agriculture and Livestock Development
MSME	Ministry of co-operatives and Micro, Small and Medium Enterprises Development
NGOs	Non government organisations
NRI	Non Ruminant Institute
PBK	Pyrethrum Board of Kenya
PDO	Project Development Objective
PFPO	Pyrethrum Farmer Producer Organization
PPCK	Pyrethrum Processing Company of Kenya
PPPs	Public Private Partnerships
PVC	Poly Vinyl Chloride
SHG	Self Help Group

SIDA	Sweden International Development Agency
T.S.P	Triple Superphosphate
TIMPs	Technologies, Innovatons and Management Practises
ToT	Training of Trainers
TV	Television
VMGs	Vulnerable and Marginalized Groups

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1.0 DEFINITION OF TERMS AND SUMMARY TABLES OF PYRETHRUM TECHNOLOGIES, INNOVATIONS, AND MANAGEMENT PRACTICES (TIMPs)

1.1 DEFINITION OF TERMS

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

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

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

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

SUMMARY OF INVENTORY OF TIMPs IN THE PYRETHRUM VALUE CHAIN

The inventory process identified TIMPs comprising **33** technologies **17** innovations and **61** management practices, distributed among the 16 sub-themes, as indicated in table 1.

Table 1: Summary of Pyrethrum TIMPs

Commodity/ value chain	Sub-Theme	Technologies	Innovations	Management Practices
Pyrethrum	Improved Pyrethrum varieties	3	0	0
Pyrethrum	Improved clones	14	0	0
Pyrethrum	Pyrethrum seed system	0	3	2
Pyrethrum	Food Safety Management Systems	0	0	2
Pyrethrum	Agronomic management Practices	0	0	11
Pyrethrum	Soil fertility management	0	6	3
Pyrethrum	Soil & water management	0	0	5
Pyrethrum	Irrigation and drainage	0	2	0
Pyrethrum	Agroforestry systems	0	0	1
Pyrethrum	Pyrethrum Crop health	0	0	14
Pyrethrum	Weed Management	0	0	7
Pyrethrum	Harvesting and Postharvest management	4	4	2
Pyrethrum	Pyrethrum Value addition	7	2	0
Pyrethrum	Mechanization of Pyrethrum production activities	5	0	0
Pyrethrum	Pyrethrum Farming Business and marketing	0	0	9

Pyrethrum	Agricultural Policy Options	0	0	5
Total		33	17	61

SUMMARY OF STATUS OF TIMPs IN PYRETHRUM VALUE CHAIN

The inventory process resulted in a total of 77 TIMPs that are ready for upscaling, 30 TIMPs that require validation and 4 TIMPs that require further research in the sub-themes, as indicated in Table 2.

Table 2: Number of TIMPs ready for upscaling, require validation or further research

Commodity/ value chain	Sub-Theme	Ready for upscaling	Requires validation	Further Research
Pyrethrum	Improved Pyrethrum varieties	2	1	0
Pyrethrum	Improved commercial pyrethrum clones	10	4	0
Pyrethrum	Pyrethrum seed system	4	1	0
Pyrethrum	GAPs and Food Safety	2	0	0
Pyrethrum	Agronomic management practices	8	2	1
Pyrethrum	Soil fertility management	6	3	0
Pyrethrum	Soil and water management	4	0	1
Pyrethrum	Irrigation and drainage	1	1	0
Pyrethrum	Agroforestry systems	0	1	0
Pyrethrum	Pyrethrum Crop health	12	2	0
Pyrethrum	Weed Management	5	2	0
Pyrethrum	Harvesting and Postharvest management	8	2	0
Pyrethrum	Pyrethrum Value addition	9	0	0
Pyrethrum	Mechanization of Pyrethrum production activities	1	3	1
Pyrethrum	Pyrethrum Farming Business and marketing	3	6	0
Pyrethrum	Agricultural Policy Options	2	2	1
Total		77	30	4

INVENTORY OF PYRETHRUM TIMPs BY CATEGORY AND STATUS

Table 3: Inventory of Pyrethrum TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.2 Improved Pyrethrum varieties and Clones	2.2.1 Varieties		
	P4	Technology	Ready for upscaling
	K218	Technology	Ready for upscaling
	K235	Technology	Requires validation
	2.2.2 Improved commercial clones		
	Ma/70/1013	Technology	Ready for upscaling
	Sb/66/107	Technology	Ready for upscaling
	Mo/70/1124	Technology	Ready for upscaling
	Ks/71/6	Technology	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	Mo/74/223	Technology	Ready for upscaling
	Ma/71/423	Technology	Ready for upscaling
	Kr/74/122	Technology	Requires validation
	Mo/74/443	Technology	Requires validation
	L/75/477	Technology	Ready for upscaling
	Ks/70/64	Technology	Requires validation
	Ks/75/4	Technology	Ready for upscaling
	L/75/487	Technology	Ready for upscaling
	Ks/75/336	Technology	Ready for upscaling
	Ks/75/313	Technology	Requires validation
2.3 Pyrethrum seed System	2.3.1 Tissue Culture Technique for Pyrethrum Seed Systems	Innovation	Ready for upscaling
	2.3.2 Semi Autotrophic Hydroponics in Pyrethrum	Innovation	Requires validation
	2.3.3 Formal Pyrethrum Seed System	Innovation	Ready for upscaling
	2.3.4 Formal Seed System - Vegetative propagation through splits	Management practice	Ready for upscaling
	2.3.5 Nursery Management	Management practice	Ready for upscaling
2.4 Food Safety Management Systems	2.4.1 Good Agricultural Practices (GAP) for Pyrethrum	Management practice	Ready for upscaling
	2.4.2 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Pyrethrum Value Chain in Kenya	Management practice	Ready for upscaling
2.5 Agronomic management practices	2.5.1 Site selection land preparation	Management practice	Ready for upscaling
	2.5.2 Land preparation	Management practice	Ready for upscaling
	2.5.3 Pyrethrum Planting, spacing and plant population	Management practice	Ready for upscaling
	2.5.4 Weeding	Management practice	Ready for upscaling
	2.5.5 Fertilizer and manure application	Management practice	Requires validation
	2.5.6 Top dressing fertilizer	Management practice	Requires further research
	2.5.7 Flower picking	Management practice	Ready for upscaling
	2.5.8 Pyrethrum cutting back	Management practice	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	2.5.9 Crop rotation	Management practice	Ready for upscaling
	2.5.10 Intercropping	Management practice	Requires validation
	2.5.11 Pyrethrum Clones/Variety selection	Management practice	Ready for upscaling
2.6 Soil fertility management	2.6.1 Fertilizer use and recommendation	Innovation	Ready for upscaling
	2.6.2 Diagnosis of plant nutrient deficiency	Innovation	Ready for upscaling
	2.6.3 Crop nutrient requirement	Innovation	Requires validation
	2.6.4 Conservation agriculture	Management practice	Ready for upscaling
	2.6.5 Soil sample testing	Innovation	Ready for upscaling
	2.6.6 Integrated Manure Management	Management Practice	Requires validation
	2.6.7 Integrated soil fertility management	Management Practice	Ready for upscaling
	2.6.8 Low cost Composting	Innovation	Ready for upscaling
	2.6.9 Rapid Soil Testing	Innovation	Requires validation
2.7 Soil and water management	2.7.1 Fanya Juu terraces	Management Practice	Ready for upscaling
	2.7.2 Contour bunds	Management Practice	Ready for upscaling
	2.7.3 Retention Ridges	Management Practice	Ready for upscaling
	2.7.4 Bench terraces	Management Practice	Ready for upscaling
	2.7.5 Mulching	Management practice	Requires further research
2.8 Irrigation and drainage Management	2.8.1 Water Testing for irrigation suitability	Innovation	Ready for upscaling
	2.8.2 Drip Irrigation (Nursery)	Innovation	Requires validation
2.9 Agroforestry	2.9.1 Agroforestry for soil fertility	Management Practice	Requires validation
2.10 Pyrethrum Crop Health	2.10.1 Integrated Management of Green Peach Aphids (<i>Myzus persicae</i>)	Management Practice	Ready for upscaling
	2.10.2 Integrated Management of Thrips (Flower Thrips and Onion thrips)	Management Practices	Ready for upscaling
	2.10.3 Integrated Management of Red Spider mites (<i>Tetranychus</i>	Management Practices	Ready for upscaling

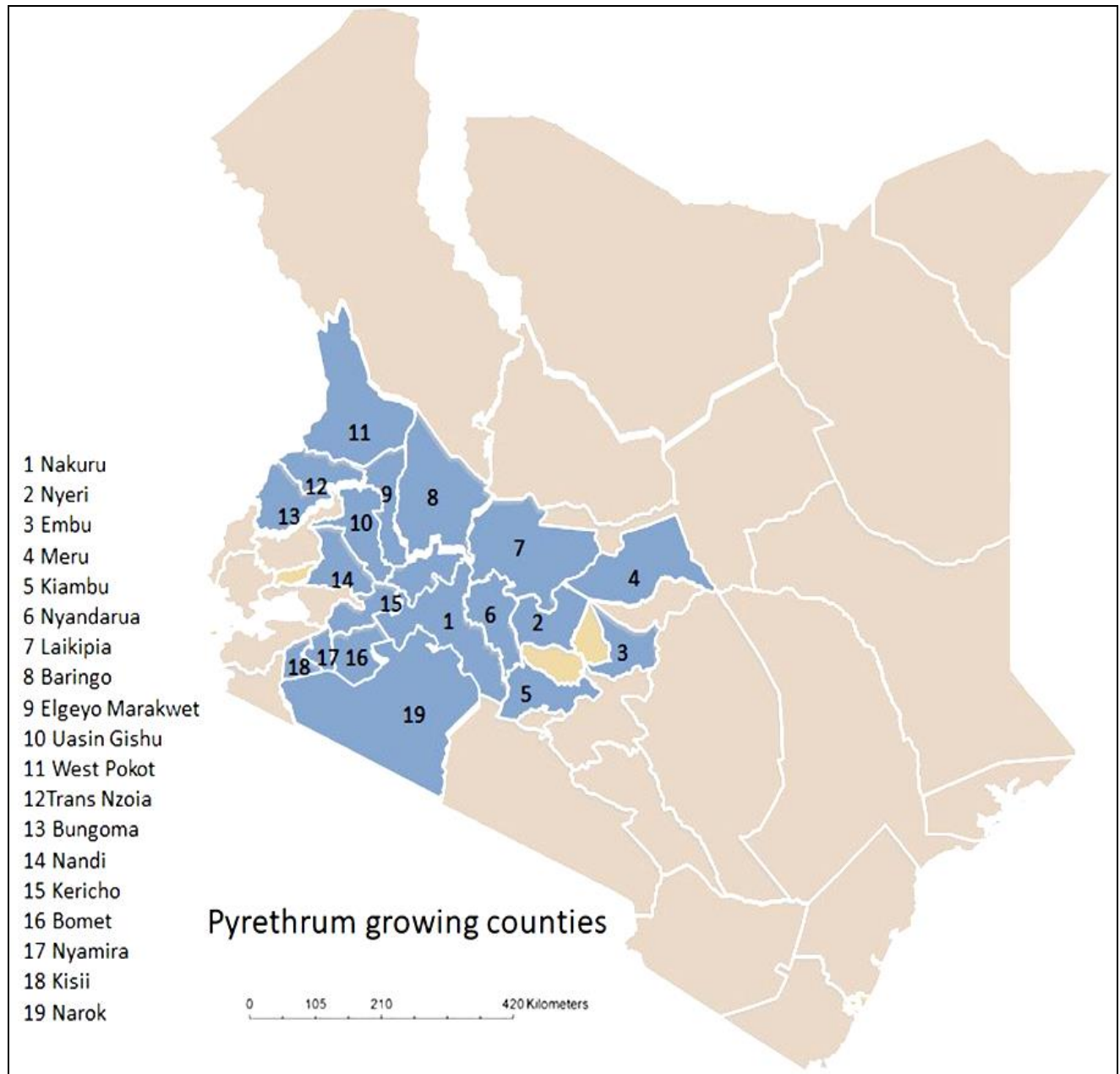
TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	<i>hudenì</i>)		
	2.10.4 Integrated Management of Leaf miner	Management Practices	Ready for upscaling
	2.10.5 Integrated Management of Scale insects	Management Practices	Requires validation
	2.10.6 Integrated Pest Management of Moles in Pyrethrum	Management Practices	Requires validation
	2.10.7 Integrated Disease management of Wilts (<i>Fusarium oxysporum</i> , <i>Fusarium solani</i> , <i>Rhizoctonia solani</i> , <i>Sclerotinia</i> spp.)	Management Practices	Ready for upscaling
	2.10.8 Integrated Disease Management of True bud disease (<i>Ascochyta</i> sp., <i>Alternaria</i> sp. <i>Ramularia bellunensis</i>)	Management Practices	Ready for upscaling
	2.10.9 Integrated Disease Management of False Flower bud disease (<i>Aphelenchoides ritsema-bosi</i>) and Frost	Management Practices	Ready for upscaling
	2.10.10 Integrated Management of Root Knot Nematode (<i>Meloidogyne</i> spp.)	Management Practices	Ready for upscaling
	2.10.11 Integrated Management of Lesion nematode (<i>Pratylenchus</i> spp.)	Management Practices	Ready for upscaling
	2.10.12 Integrated Disease Management of Crown Rot diseases (<i>Fusarium</i> spp., <i>Rhizoctonia</i> spp. <i>Sclerotinia minor</i> ., <i>Ascochyta</i> spp.)	Management Practices	Ready for upscaling
	2.10.13 Integrated DiseaseManagement of Flower blight (<i>Sclerotinia Sclerotiorum</i> , <i>Phoma</i> spp., <i>Alternaria</i> spp., <i>Botrytis cinerea</i>)	Management Practices	Ready for upscaling
	2.10.14 Integrated Disease Management of	Management Practices	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	Integrated of Tomato spotted wilt virus (TSWV)		
2.11 Weed Management	2.11.1 Integrated Weed Management in Pyrethrum	Management Practice	Requires validation
	2.11.2 Intercropping for weed management in pyrethrum	Management Practice	Ready for upscaling
	2.11.3 Mulching for weed management in Pyrethrum	Management Practice	Ready for upscaling
	2.11.4 Solarization for weed management in pyrethrum	Management Practice	Ready for upscaling
	2.11.5 Hand weeding in pyrethrum production	Management Practice	Ready for upscaling
	2.11.6 Stale seed bed for weed management in pyrethrum	Management Practice	Requires validation
	2.11.7 Crop rotation for weed management in Pyrethrum	Management Practice	Ready for upscaling
2.12 Harvesting and Postharvesting	2.12.1 Maturity indices	Management practice	Ready for upscaling
	2.12.2 Harvesting Procedure	Innovation	Ready for upscaling
	2.12.3 Harvesting basket	Technology	Requires validation
	2.12.4 Improved sun-drying pyrethrum drying	Management practice	Ready for upscaling
	2.12.5 Drying of pyrethrum flowers on raised pyrethrum wire mess tray with open roof	Innovation	Ready for upscaling
	2.12.6 Drying of pyrethrum flowers on solar dryers	Innovation	Ready for upscaling
	2.12.7 Combustion drying of pyrethrum flowers	Innovation	Ready for upscaling
	2.12.8 Biodegradable Pyrethrum storage bags	Technology	Requires validation
	2.12.9 Pyrethrum stores	Technology	Ready for upscaling
	2.12.10 Pyrethrum Moisture Meter	Technology	Ready for upscaling
2.13 Value	2.13.1 Burning on jikos to	Innovation	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
Addition (i) Cottage utilization (ii) Crop protection (iii) Livestock sprays (iv) Public health (insecticides) (v) Human medicine	produce repellant smoke		
	2.13.2 Pyrethrum broom	Innovation	Ready for upscaling
	2.13.3 Crop protection products (sprays)	Technology	Ready for upscaling
	2.13.4 Livestock sprays	Technology	Ready for upscaling
	2.13.5 Insecticides (mosquito coils)	Technology	Ready for upscaling
	2.13.6 Storage dusts for food stores and warehouses	Technology	Ready for upscaling
	2.13.7 Lotions, shampoos and gels	Technology	Ready for upscaling
	2.13.8 Animal feed – py-mack (by-products)	Technology	Ready for upscaling
	2.13.9 Manure (by-products)	Technology	Ready for upscaling
2.14 Mechanization of Pyrethrum production activities	2.14.1 Improved Pyrethrum solar dryers	Technology	Ready for upscaling
	2.14.2 Pyrethrum harvesters	Technology	Requires further Research
	2.14.3 Improved pyrethrum tractor drawn ridger	Technology	Requires validation
	2.14.4 Motorizing pyrethrum cut-back	Technology	Requires validation
	2.14.5 Biomass dryer	Technology	Ready for validation
2.15 Pyrethrum farming business and marketing and systems	2.15.1 Contracted production model	Management practices	Ready for upscaling
	2.15.2 Forming farmer producer organization	Management practices	Ready for upscaling
	2.15.3 Farmers' established quality seed farm model	Management practices	Requires validation
	2.15.4 Farmer to farmer clonal splits model	Management practices	Requires validation
	2.15.5 Business Planning model	Management practices	Ready for upscaling
	2.15.6 Processing diversification - entrepreneurship model	Management practices	Requires validation
	2.15.7 Internet/mobile marketing applications	Management practices	Requires validation
	2.15.8 Farmer group' forums for agricultural advisory services	Management practices	Requires validation
	2.15.9 Participatory market research	Management practices	Requires validation
3.1 Agricultural Policy Options	3.1.1 Integrating Crops Act 2013	Management Practices	Ready for upscaling

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
	3.1.2. County Integrated Development Planning	Management practices	Ready for upscaling
	3.1.3 National Agricultural Strategy Framework	Management practices	Further Research
	3.1.4 Agricultural Policy Strategy Framework	Management Practices	Requires validation
	3.1.5. Policy cycle	Management Practices	Requires validation


2.1 DETAILED PYRETHRUM VALUE CHAIN TIMPs



2.2 IMPROVED VARIETIES AND CLONES

2.2.1 Improved pyrethrum varieties

2.2.1.1 Variety P4 (Technology)

2.2.1.1 TIMP Name	Variety P4
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields and low pyrethrin content as a result of shortage of high yielding pyrethrum planting material.
What is it? (TIMP description)	P4 variety is a high yielding variety with potential of producing between 600-800 kg/ha/year. It has medium to long sparsely spaced ray florets with high pyrethrin content of up to 2.0%. The variety is best suited for high altitude areas with altitudes of 2100 m asl and above. It is susceptible to bud disease during extreme wet conditions. This variety has a High Pyrethrin content of 2.0%.
Justification	As a high yielding variety with good quality of flowers and wideadaptability across many ecological zones, P4 variety is adaptable in most agro-ecological zones where pyrethrum growing is done.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, farmers, research service providers, extension service providers, pyrethrum nursery operators, agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents

	<ul style="list-style-type: none"> • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through farmer training • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies and Innovations • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain Activities, e.g., nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	To be up scaled in: Bomet, Nyandarua, Kakamega and Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that does not meet the grower's demand • Inadequate infrastructure for maintenance and perpetuation of planting material • Inadequate extension services • Limited investment in research and development of improved planting materials • Perception-related issues among the target farmer groups
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and the semi-autotrophic method


	<ul style="list-style-type: none"> • Investment in infrastructure that provides an enabling environment for healthy production of planting materials, such as irrigation facilities • Providing avenues for capacity building across the value chain to enhance extension work • Investing more in research work to facilitate the development of new technologies and innovations • Working with the immediate leaders of the target farmer groups to ease the transfer of information • Campaigning for attitude change
Lessons learnt in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas to preserve planting material • Providing planting material in close proximity to farmers is necessary for upscaling plans • Counties need to invest more in supporting farmers in the pyrethrum value chain during the formative years
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop • The adoption of crop will pick especially if complemented with training and backstopping • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre
Estimated returns	<ul style="list-style-type: none"> • 500 kg per acre per year @ 350 per kg = KES 175,000 • Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to production resources such as land, knowledge, information, extension, training, credit and quality plant material
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required inputs such as credit. • Youth and women groups to produce and multiply quality/certified plant material. • At the initial stage of crop development, the uncovered ground offers opportunities for intercropping with short legumes, thereby increasing household income and food security. • Opportunities in marketing for women and youth provide an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation . • VMGs have less access to agricultural information, technology and knowledge . • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers.

	<ul style="list-style-type: none"> • VMGs have limited access to education, training and extension services . • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower-picking baskets. • At the initial stage of crop development, the uncovered grounds offer opportunities for intercropping with short legumes thereby increasing household income and food security.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new pyrethrum growing zones in Kenya, such as Elgeiyo-Marakwet, indicates that the crop has an impact on the socio-economic well-being of the farmers. <p>The renewed interest of farmers in this value chain has been facilitated by the increased support and incentives from the government, as well as the emergence of new players, such as private processing companies.</p>
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure (62/2008) 2. KALRO Pyrethrum seedlings mobile App (2019)
F: Status of TIMP readiness (1-ready for up scaling; 2-requires validation; 3-requires further research)	Ready for up scaling.
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100 - 20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.1.2 Variety K218 (Technology)

2.2.1.2 TIMP Name	Variety K218
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low production, coupled with low pyrethrin content in available varieties and clones. These led to low adoption of pyrethrum farming due to poor production and low returns.
What is it? (TIMP description)	K218 variety has high potential of producing between 900-1000 kg of dry flowers per ha/year with the highest pyrethrin content (2.1%). This variety is best suited for low to medium altitude areas Upto 1700 m asl.
Justification	Variety K218 being high yielding with high pyrethrin content and adapted to a wide agro-ecological zone, it is a best bet for addressing farmers concerns of low pyrethrin content and low yields in potential pyrethrum growing areas.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, farmers, research service providers, fxtension service providers, pyrethrum nursery operators, agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models

	<ul style="list-style-type: none"> • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through farmer trainings. • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service providers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies and Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities. e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services and regulation of on farm demonstration. Provision of infrastructure (e.g., driers and irrigation facilities). • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand of dry pyrethrum • Limited investment in research and development of improved planting materials • Language barrier • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision • Perception issues among the target farmer groups
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method

	<ul style="list-style-type: none"> • Investment in infrastructure that provides an enabling environment for healthy production of planting materials, such as irrigation facilities • Providing avenues for capacity building across the value chain to enhance extension work including the training of trainers. • Investing more in research work to facilitate the development of new technologies and innovations. • Working with the immediate leaders of the target farmer groups to ease the transfer of information. • Campaigning for attitude change
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas to preserve planting material • Providing planting material in close proximity to farmers is necessary in the upscaling plans. • Counties need to invest more in supporting farmers in the pyrethrum value chain during the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop • The adoption of crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carry out most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to


	<p>acquire required input such as credit.</p> <ul style="list-style-type: none"> • Youth and women groups to produce and multiply quality/certified plant material. • At the initial stage of crop development, the uncovered ground offers opportunity for intercropping with short legumes, thereby increasing household income and food security. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material • VMG cottage industries to fabricate and produce flower picking baskets • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The renewed interest of farmers in this value chain has been made possible by the increased support and incentives from the government, emergence of new players, such as private processing companies.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for up scaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106

	Molo Kalro.molo@kalro.org 2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.1.3 Variety K235 (Technology)

2.2.1.3 TIMP	Variety K235
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields and low pyrethrin content as a result of shortage of high yielding pyrethrum planting material.
What is it? (TIMP description)	K235 variety is a high yielding variety with potential of producing between 600-800 kg/ ha/year. It has pyrethrin content of 1.9%. and is best suited for low to medium altitude areas with altitudes of up to 1700 m A.S.L and above.
Justification	Variety K235 being highly adapted to a wide agro-ecological zone, it is a best bet suited for addressing concerns of addressing the issues of lack of tolerance adverse abiotic conditions of the environment.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators, agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches. • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through farmer trainings. • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain activities. i.e nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services and regulation of on farm demonstration. • Provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet,

	Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the growers demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension services • Limited investment in research and development of improved planting materials. • Perception related issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method • Investment in infrastructure that provides an enabling environment for healthy production of planting materials such irrigation facilities • Providing avenues for capacity building across the value chain to enhance extension work including training of trainers • Investing more in research work to facilitate the development of new technologies and innovations • Working with the immediate leaders of the target farmer groups to ease the transfer of information. • Campaign for attitude change
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas to preserve planting material • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Counties need to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt new clones and varieties. • Favorable weather conditions. • Availability of consistent markets. • Favorable policies to support plant material production, marketing and eventual value addition.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	500 kg per acre per year @ 350 per kg = KES 175,000. Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to

	<p>other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety</p> <ul style="list-style-type: none"> • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Youth and women groups to produce and multiply quality/certified plant material. • At the initial stage of crop development, the uncovered grounds offer opportunity for intercropping with short legumes, thereby increasing household income and food security. • Opportunity in marketing for women and youth. Provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge . • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered grounds offers opportunity for intercrop with short legumes hence increased household income and food security. • Affirmative action opportunities exist for VMGs to acquire the required credit.


E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players such as private processing companies.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3-requires further research)	Requires validation.
G. Contacts	
Contacts	<p>1) Centre Director, KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones

2.2.2 Improved commercial clones

2.2.2.1 Clone Ma/70/1013 (Technology)

2.2.2.1 TIMP Name	Clone Ma/70/1013
	
Category (i.e. technology, innovation or management practice)	Technology.
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields and low pyrethrin content as a result of shortage of high yielding pyrethrum planting material.
What is it? (TIMP description)	Clone Ma/70/1013 is a high yielding clone with the potential of producing between 1100-1200 Kg of dry flowers/ha/year. It has pyrethrin content of 1.9% making it one of the best clone suited for high altitude of up to 2200 m asl. It is also tolerant to lodging hence reduces losses when laden with flowers.
Justification	Clone Ma/70/1013 is best suited for addressing the issues of low pyrethrin content in other varieties/clones and low yields in pyrethrum potential areas. This is because it synthesizes high concentration of pyrethrins and produces best quality of flowers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches. • Involvement of all value chain stakeholders in promotion processes. • Effective awareness creation through farmer trainings. • Backstopping and training impact assessment. • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: to adopt varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the grower's demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension services. • Limited investment in research and development of improved planting materials. • Perception related issues by the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method.

	<ul style="list-style-type: none"> • Investment in infrastructure that provides an enabling environment for healthy production of planting materials. Such infrastructure include: irrigation facility. • Provide avenues for capacity building across the value chain to enhance extension work including the training of trainers. • Investing more in research work to develop new technologies and innovations. • Working with the immediate leaders of the target farmer groups. This will ease the transfer of information. • Campaign for attitude change
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop • The adoption of crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties


Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • At the initial stage of crop development, the uncovered grounds offer opportunity for intercropping with short legumes, thereby increasing household income and food security • Opportunity in marketing for women and youth. Provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<p>Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers.</p> <p>The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, emergence of new players. i.e. Private processing</p>
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	1) Centre Director KALRO-Molo (ICRC)

	P.O. Box 100-20106 Molo Kalro.molo@kalro.org 2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.2 Clone Sb/66/107 (Technology)

2.2.2.2 TIMP Name	Clone Sb/66/107
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low flower yields, low adaptability in the pyrethrum growing area and low pyrethrin content as a result of shortage of high yielding pyrethrum planting material.
What is it? (TIMP description)	Clone Sb/66/107 is a highly productive clone with the potential of producing between 900-1000 Kg of dry flowers/ha/year.

	It has Pyrethrin content of 2.0% making it one of the best clone suited for high altitude of up to 2200 masl. It is also tolerant to environmental stresses due to its inherent adaptive features.
Justification	Clone Sb/66/107 is a high yielding variety with good quality of flowers and exhibits tolerance to abiotic factors of the environment such as temperature extremes and soil moisture stresses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	The users of this TIMP include: Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches. • Involvement of all value chain stakeholders in promotion processes. • Effective awareness creation through farmer trainings. • Backstopping and training impact assessment. • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and pathways, • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: To adopt the varieties

C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision. • Limited investment in research and development of improved planting materials. • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials such as irrigation facilities. • Provide avenues for capacity building across the value chain to enhance extension work. This include Training of trainers. • Investing more in research work to necessitate evolution of new technologies and innovations. • Working with the immediate leaders of the target farmer groups. This will ease the transfer of information. • Campaign for attitude change
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material. • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety


	<ul style="list-style-type: none"> • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • At the initial stage of crop development, the uncovered grounds offer opportunity for intercropping with short legumes, thereby increasing household income and food security • Opportunity in marketing for women and youth. Provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers . • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, emergence of new players. i.e. Private processing

Application guidelines for users	1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for up scaling, 2- requires validation; 3-requires further research)	Ready for up scaling
Contacts	1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org 2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.3 Clone Mo/70/1124 (Technology)

2.2.2.3 TIMP Name		Clone Mo/70/1124	
			
Category (i.e. technology, innovation or management practice)	Technology		
A: Description of the technology, innovation or management practice			
Problem to be addressed	Low yields and lack of planting materials adaptable to the specific areas with regard to altitudes.		


What is it? (TIMP description)	Clone Mo/70/1124 is a highly productive clone with the potential of producing between 900-1000 Kg of dry flowers/ha/year. It has a pyrethrin content of 1.9 % and bear good quality of flowers. It is well adapted for high altitude of up to 2200 masl. It is also tolerant to environmental stresses due to its evident adaptive features.
Justification	Clone Mo/70/1124 is best suited for addressing the issues of low pyrethrin content as well as the shortage of flowers to match the increased demand for dry flowers. This is because it synthesizes high concentration of pyrethrins and produces best quality of flowers. It is also tolerant to abiotic factors like high temperature and water loss due to the adaptive feature of the foliage tissues. The clone is hardy and maintains high yield due to its ability to withstand harsh environmental conditions.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, farmers, research service providers, extension service providers, pyrethrum nursery operators and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches. • Involvement of all value chain stakeholders in promotion processes. • Effective awareness creation through farmer trainings. • Backstopping and training on impact assessment. • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment.

	<ul style="list-style-type: none"> • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services and regulation of on farm demonstration. • Provision of infrastructure. i.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers • Willing farmers in target areas: To adopt the varieties.
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> • Perception issues among the target farmer groups. • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material • Inadequate extension service provision • Limited investment in research and development of improved planting materials.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials such as irrigation facilities. • Provide avenues for capacity building across the value chain to enhance extension work. • Investing more in research work to necessitate evolution of new technologies and innovations. • Working with the immediate leaders of the target farmer groups. This will ease the transfer of information. • Campaign for attitude change
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material. • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Approximately 100,000 Ksh per acre per year.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence

	<p>increased household income and food security</p> <ul style="list-style-type: none"> • Opportunities for youths exists in transportation of the produce to the market
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players such as private processing companies
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100 - 20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

2.2.2.4 Clone Ks/71/6 (Technology)

2.2.2.4 TIMP Name		Clone Ks/71/6	
			
Category (i.e. technology, innovation or management practice)	Technology		
A: Description of the technology, innovation or management practice			
Problem to be addressed	Low flower productivity and susceptibility to environmental stresses.		
What is it? (TIMP description)	Clone Ks/71/6 meant for low to medium altitude areas of upto 1700 m A.S.L. and has the potential of producing between 900-1000 Kg of dry flowers/ha/year. It has Pyrethrin content of 1.7% and is adapted to wide Agro-ecological zones. This renders it tolerant to environmental stresses. It has the potential of producing 900-1000 Kg of dry flowers/ha/year.		
Justification	Clone Ks/71/6 is best suited for addressing the issues of shortage of flowers to match the increased demand for dry flowers. The clone is highly adaptatable tolerant to abiotic factors such as high temperature and water loss.		
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs.		
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer to farmer extension models• Mass media – Electronic and print• Publications -posters/brochures/leaflets, manuals• Digital Platforms– Website, Dashboards, Apps, social media short message services		
Critical/essential factors for successful promotion	<ul style="list-style-type: none">• Preferred traits by farmers, consumers and market niches• Involvement of all value chain stakeholders in promotion processes• Effective awareness creation through farmer trainings		

	<ul style="list-style-type: none"> • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> • KALRO-Molo: Research and development of technologies/Innovations • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain activities, e.g.,nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Provision of infrastructure. i.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers • Willing farmers in target areas: To adopt the varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material • Inadequate extension service provision • Limited investment in research and development of improved planting materials • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method • Investment in infrastructure that provides an enabling environment for healthy production of planting materials such as irrigation facilities • Provide avenues for capacity building across the value chain to enhance extension work • Investing more in research work to facilitate the development of new technologies and innovations • Working with the immediate leaders of the target farmer groups to ease the transfer of information • Campaign for attitude change.


Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material. • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain to ensure easy flow of operations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety. • Women and youth have less access to land which limits them from fully adopting the variety. • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety. • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores. • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Youth and women groups to produce and multiply quality/certified plant material. • At the initial stage of crop development, the uncovered grounds offer opportunity for intercropping with short legumes, thereby increasing household income and food security. • Opportunity in marketing for women and youth. Provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation . • VMGs have less access to agricultural information, technology and knowledge .

scaling up	<ul style="list-style-type: none"> • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers . • VMGs have limited access to education, training and extension services . • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • Opportunities for youths exists in transportation of the produce to the market
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players such as private processing companies.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.5 Clone Mo/74/223 (Technology)

2.2.2.5 TIMP Name -		CloneMo/74/223	
			
Category (i.e. technology, innovation or management practice)	Technology		
A: Description of the technology, innovation or management practice			
Problem to be addressed	Low yields, vulnerability to abiotic and biotic causes of plant diseases. Additionally,there is also lodging of clones/varieties with slender stems when laden with flowers.		
What is it? (TIMP description)	Being a high yielding with a potential flower production of 900-1000 Kg and a pyrethrin content of 1.95%, Clone Ma/74/223 is a suitable choice for growing in high altitude areas (2200 masl) where other varieties experienced poor adaptability to biotic, abiotic stresses and lodging caused by high production.		
Justification	Clone Ma/74/223 is best suited for addressing the issues of low pyrethrin content in other varieties/clones and low yields in pyrethrum potential areas. This is because it produces highquality flowers and is resistant to lodging.		
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs.		
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer to farmer extension models• Mass media – Electronic and print• Publications -posters/brochures/leaflets, manuals• Digital Platforms – Website, Dashboards, Apps, social media short message services		

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Promotion methods used • Involvement of all value chain stakeholders in promotion processes • Creation of awareness through farmer trainings. • Backstopping and training impact assessment • Provision of increased resources to support public extension services
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/Innovations. • PPCK: Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments: Provision of extension services and regulation of on farm demonstration. • Provision of infrastructure. I.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Farmers in target areas: Beneficiaries of a development initiative.
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and propagation of planting materials • Inadequate extension service provision • Limited investment in research and development of improved planting materials. • Language barrier • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Provide avenues for capacity building across the value chain to enhance extension work including training of trainers. • Investing more in research to develop new technologies and innovations. • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Working with the immediate leaders of the target farmer groups to overcome language barriers and ease the transfer of information. • Investment in irrigation to provide for healthy production of

	planting materials.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Need for strong collaboration between all the actors of the value chain. • There is need to have pyrethrum germplasms reservoirs in pyrethrum potential areas for necessity of preservation of planting material. • Provision of material in close proximity to farmers is eminent in the up scaling plans. • There is need to increase revenue allocation to boost the pyrethrum value chain operations.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt new clones and varieties. • Favorable weather conditions. • Availability of consistent markets. • Favorable policies to support plant material production, marketing and eventual value addition.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 KES realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology


adoption and scaling up	<p>and knowledge</p> <ul style="list-style-type: none"> • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • Opportunities for youths exists in transportation of the produce to the market
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players such as private processors
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019 3. Agriculture and Food Authority Pyrethrum growers manual 3rd edition-2019
F: Status of TIMP readiness (1-ready for upscaling;, 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100 - 20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.

2. Breeding to produce new pyrethrum clones.

2.2.2.6 Clone Ma/71/423 (Technology)

2.2.2.6 TIMP Name		Clone Ma/71/423	
			
Category (i.e. technology, innovation or management practice)	Technology		
A: Description of the technology, innovation or management practice			
Problem to be addressed	High susceptibility to environmental stresses and lack of high yielding planting material for medium to low altitude areas.		
What is it? (TIMP description)	Clone Ks/71/423 has a potential of producing 1000-1100 Kg of dry flowers/ha/year and pyrethrin content of 1.8%. It is adaptable for low altitude to medium altitude areas (areas of up to 1700 m a.s.l).		
Justification	The adaptability of Clone Ma/71/423 to the low altitude to medium altitude areas and its high yield makes the clone suitable for growing in hot and dry areas in the low to medium altitude zones.		
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP	Breeders, Farmers, research service providers, extension service providers, pyrethrum nursery operators.		
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer to farmer extension models• Mass media – Electronic and print• Publications -posters/brochures/leaflets, manuals• Digital Platforms– Website, Dashboards, Apps, social media short message services		

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches. • Involvement of all value chain stakeholders in promotion processes. • Effective awareness creation through farmer trainings. • Backstopping and training • Availability, accessibility and affordability of certified seeds and plant materials • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/Innovations. • PPCK: Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments: Provision of extension services and regulation of on-arm demonstration. • Provision of infrastructure. I.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Farmers in target areas: Beneficiaries of a development initiative.
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision. • Limited investment in research and development of improved planting materials. • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Provide avenues for capacity building across the value chain to enhance extension work including training of trainers. • Investing more in research to develop new technologies and innovations. • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method • Working with the immediate leaders of the target farmer groups.


	<p>This will ease the transfer of information.</p> <ul style="list-style-type: none"> Investment in irrigation to provide healthy production of planting materials.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas. Providing planting material in close proximity to farmers is necessary in the up scaling plans. Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<p>Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop.</p> <ul style="list-style-type: none"> The adoption of the crop will pick especially if complemented with training and backstopping. Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations. Promotion of planting materials according to environmental requirements.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties Men as household heads dominate most of the production decision processes which may discourage women from adopting the variety Women and youth have less access to land which limits them from fully adopting the variety.
Gender related opportunities	<ul style="list-style-type: none"> Affirmative action opportunities to women and youth to acquire required input such as credit. At the initial stage of crop development, the uncovered grounds offer opportunity for intercropping with short legumes, thereby increasing household income and food security Opportunity in marketing for women and youth. Provides an enabling environment for them to dispose of their produce.

	<ul style="list-style-type: none"> • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • Opportunities for youths exists in transportation of the produce to the market.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players such as private processors
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO:Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis Kingori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.7 Clone Kr/74/122 (Technology)

2.2.2.7 TIMP Name	Clone Kr/74/122
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low pyrethrin content and lack of choice high yielding materials adapted to abiotic stresses.
What is it? (TIMP description)	Clone kr/74/122 is a high yielding clone (potential of 1000-1100 Kg of dry flowers/ha/year) with a high pyrethrin content (2.1%) . It best suited is suitable for growing in medium altitude of 1700 masl.
Justification	Clone kr/74/122 is a high yielder and reknowned for high pyrethrin content in medium altitudes. It is the best bet suited for addressing low pyrethrin content as well as the shortage of flowers to match the increased demand for dry flowers. It is also tolerant to high temperature and water loss due to the dissections on the leaves common in the medium altitudes.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, farmers, research service providers, extension service providers, pyrethrum nursery operators and agripreneurs .
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents

	<ul style="list-style-type: none"> • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through extension • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Provision of infrastructure. i.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: To adopt the varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and propagation of planting material. • Inadequate extension service provision • Limited investment in research and development of improved

	planting materials <ul style="list-style-type: none"> • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method • Working with the immediate leaders of the target farmer groups to ease the transfer of information • Investment in irrigation to provide production of planting materials • Improve capacity building across the value chain to enhance extension work through training. • Investing more in research to develop new technologies and innovations. • Campaign for attitude change
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain to ensure easy flow of operations • Provide information on what areas are best suited for particular varieties and clones of pyrethrum.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties • Men as household heads dominate most of the production decision processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them


	<p>from fully adopting the variety</p> <ul style="list-style-type: none"> • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • At the initial stage of crop development, the uncovered grounds offer opportunity for intercrop with short legumes, thereby increasing household income and food security • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness. • VMGs have limited access to land for pyrethrum cultivation . • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security • Opportunities for youths exists in transportation of the produce to the market
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and emergence of new players.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019 3. Agriculture and food Authority pyrethrum growers manual 3rd edition-2019
F: Status of TIMP readiness (1-ready for upscaling;, 2- requires	Requires validation

validation; 3-reques further research)	
G. Contacts	
Contacts	1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org 2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.8 Clone Mo/74/443 (Technology)

2.2.2.8 TIMP Name	Clone Mo/74/443
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low pyrethrum production, low pyrethrin content in flowers and susceptibility to abiotic stresses.
What is it? (TIMP description)	Clone Mo/74/443 has a potential of producing 1000-1100 Kg of dry flowers/ha/year with Pyrethrin content of 2.1% and is best suited for high altitude areas (2200 m asl). The clone is tolerant to harsh abiotic factors common in these highlands.
Justification	As a high yielder of dry flowers and pyrethrin content, Clone Ma/74/443 is best suited for growing in highlands because it is tolerant to extreme temperature conditions.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Users of this TIMP Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through farmer trainings • Backstopping and training • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<p>KALRO: Research and development of technologies/ Innovations.</p> <ul style="list-style-type: none"> • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain Activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Provision of infrastructure. i.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: To adopt the varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet,

	Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Perception issues from the target farmer groups • Limited investment in research and development of improved planting materials. • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Campaign for attitude change • Investment in irrigation to provide production of planting materials. • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method. • Invest in capacity building in the value chain through extension work. • Investing more in research work to facilitate the evolution of new technologies and innovations. • Work with immediate leaders of target farmer groups to ease information transfer.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material Providing planting material in close proximity to farmers is necessary in the up scaling plans • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Intensive and sustained training of farmer groups may persuade the farmers to adopt the crop. • The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations. • Provision of adequate information of which varieties and clones can be grown in the respective areas based on suitability index.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety


	<ul style="list-style-type: none"> • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input of production such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security • Opportunities for youths exists in transportation of the produce to the market
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019

F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
G. Contacts	
Contacts	1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org 2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments(Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.9 Clone L/75/477 (Technology)

2.2.2.9 TIMP Name	Clone L/75/477
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low production of dry pyrethrum flowers with low pyrethrin content and lack of adaptable varieties to abiotic stresses in the country
What is it? (TIMP description)	Clone L/75/477 is a high yielding variety (potential of 1000-1200 kg/ha/year) with high pyrethrin content of up to 2.1%. It is best suited for high altitude areas ranging from 2100 masl and above.
	The high yielding Clone L/75/477 is best suited for highland pyrethrum

Justification	potential areas since it has high dry flower production with high pyrethrin content. The clone synthesizes high proportions of pyrethrins quality flowers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through enhanced extension services • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and pathways • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain Activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Provision of infrastructure. i.e. driers and irrigation facilities. • Nursery operators: Establishment of nurseries and supply of planting materials to farmers.

	<ul style="list-style-type: none"> • Willing farmers in target areas: Adoption of varieties.
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and propagation of planting material. • Inadequate extension service provision • Limited investment in research and development of improved planting materials • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Working with the immediate leaders of the target farmer groups. This will ease the transfer of information. • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials such as irrigation facilities • Provide avenues for capacity building across the value chain to enhance extension work. This includes training of trainers. • Investing more in research work to develop new technologies and innovations.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material. • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations. • Provision of information to guide farmers wht varietieSs to grow in respective regions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 sh.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination,	<ul style="list-style-type: none"> • While women and youth carryout most of the farm activities, revenue from Pyrethrum is controlled by men, limiting women


adoption and scaling up	<p>and youth from adoption</p> <ul style="list-style-type: none"> • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety
Gender related opportunities	<ul style="list-style-type: none"> • At the initial stage of crop development, the uncovered grounds offer opportunity for intercropping with short legumes, thereby increasing household income and food security • Affirmative action opportunities to women and youth to acquire required input such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness. • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit. • At the initial stage of crop development, the uncovered ground offers opportunity for intercropping with short legumes thereby increasing household income and food security • Opportunities for youths exists in transportation of the produce to the market
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has

	<p>an impact on the socio-economic well-being of the farmers.</p> <p>The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players.</p>
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments(Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.10 Clone Ks/70/64 (Technology)

2.2.2.10 TIMP Name	Clone Ks/70/64
	

Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of adaptable pyrethrum varieties and clones to abiotic factors with adequate of dry flower pyrethrum production.
What is it? (TIMP description)	Clone Ks/70/64 is not only suited for growing in low to medium altitude (1700 masl.) but also is a high yield of dry flowers (1000-1100 Kg of dry flowers/ha/year) with a moderate pyrethrin content(1.9%).
Justification	Clone Ks/70/64 is adaptable to medium altitudes because it has high yields and is tolerant to extreme temperatures besides producing quality of flowers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Involvement of all value chain stakeholders in promotion processes • Effective awareness creation through farmer trainings • Backstopping and training impact assessment • Availability, accessibility and affordability of certified seeds • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service providers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value


	<p>chain</p> <p>Activities, e.g., nursery establishment.</p> <ul style="list-style-type: none"> • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision. • Limited investment in research and development of improved planting materials. • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials, such as irrigation facilities. • Provide avenues for capacity building across the value chain to enhance extension work. This includes training of trainers. • Investing in research to develop new technologies and innovations. • Work with leaders of the target farmer groups to ease information transfer.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasms reservoirs in pyrethrum potential areas for preservation of planting material. • Providing material in close proximity to farmers is eminent in the up scaling plans. • There is need to increase revenue allocation to boost the

	pyrethrum value chain operations.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations. • Provision of information to enable farmers to match clones and varieties to respective agroclimatic regions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 ksh per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • While women and youth carryout most of the farm activities, revenue from Pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for men exists in pyrethrum production and marketing • Opportunities for youths exists in transportation of the produce to the market • Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from

	<p>decision making in development and dissemination activities.</p> <ul style="list-style-type: none"> • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
<p>• E: Case studies/profiles of success stories</p>	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and emergence of new players.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	Requires validation
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100 - 20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

2.2.2.11 Clone Ks/75/4 (Technology)

2.2.2.11 TIMP Name	Clone Ks/75/4
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Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields of pyrethrum flowers and lack of adaptable clones and varieties to abiotic factors of the environment.
What is it? (TIMP description)	Clone Ks/75/4 is best suited for low to medium altitude of up to 2200 m asl. It has the potential of producing between 900-1000 kg of dry flowers/Ha/year and pyrethrin content of 1.9%.
Justification	The high yielding Clone Ks/75/4 is a best bet adaptable to abiotic factors and inadequacy of dry flowers to match demands. This is because it is tolerant to extreme temperature conditions and synthesizes high concentration of pyrethrins besides producing good quality of flowers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators, agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches.

successful promotion	<ul style="list-style-type: none"> • Involvement of all value chain stakeholders in promotion processes. • Effective awareness creation through farmer trainings. • Backstopping and training impact assessment. • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain Activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision. • Limited investment in research and development of improved planting materials. • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials, such as irrigation facilities • Provide avenues for capacity building across the value chain to enhance extension work including training of trainers.

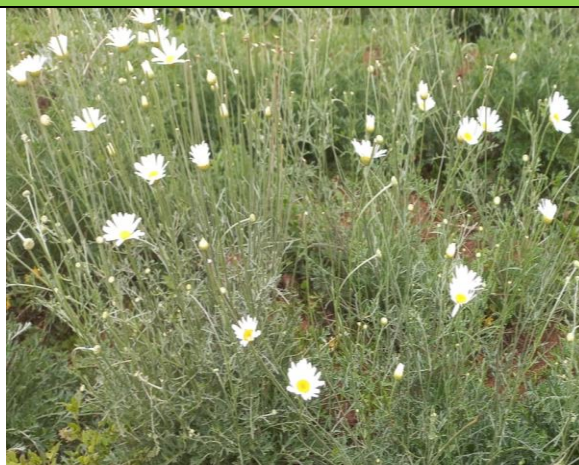
	<ul style="list-style-type: none"> Investing more in research work to develop new technologies and innovations. Working with the immediate leaders of the target farmer groups to ease information transfer
Lessons learned in up scaling if any	<ul style="list-style-type: none"> There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas for preservation of planting material. Providing planting material in close proximity to farmers is necessary in the up scaling plans. Need for counties to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<p>Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop.</p> <ul style="list-style-type: none"> The adoption of the crop will pick especially if complemented with training and backstopping. Involvement of all the stakeholders in the pyrethrum value chain will ease of coordination. Provision of adequate information will ensure matching of clones and varieties to specific
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	500 kg per acre per year @ 350 per kg = KES 175,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety Women and youth have less access to land which limits them from fully adopting the variety Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety While women and youth carry out most of the farm activities, revenue from Pyrethrum is controlled by men, limiting women and youth from adoption The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties.
Gender related opportunities	<ul style="list-style-type: none"> Affirmative action opportunities to women and youth to acquire required input such as credit. Opportunity in marketing for women and youth. Provides an enabling environment for them to dispose of their produce. Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> VMGs have limited access to land for pyrethrum cultivation VMGs have less access to agricultural information, technology and

adoption and scaling up	<p>knowledge</p> <ul style="list-style-type: none"> • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
<p>• E: Case studies/profiles of success stories</p>	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, emergence of new players.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director, KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nkuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.12 Clone L/75/487 (Technology)

2.2.2.12 TIMP Name		Clone L/75/487	
			
Category (i.e. technology, innovation or management practice)	Technology		
A: Description of the technology, innovation or management practice			
Problem to be addressed	Low yields of pyrethrum flowers and low pyrethrin content in earlier clones and varieties.		
What is it? (TIMP description)	Clone L/75/487 is best suited for high altitude of up to 2100 and above. It has the potential of producing 1100-1200 Kg of dry flowers/ha/year.		
Justification	Clone L/75/487 is tolerant to abiotic factors and a heavy producer of good quality flowers. It is the best suited for growing in the highlands because of its high productivity.		
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators, and agripreneurs		
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer to farmer extension models• Mass media – Electronic and print• Publications -posters/brochures/leaflets, manuals• Digital Platforms – Website, Dashboards, Apps, social media short message services		
Critical/essential factors for successful promotion	<ul style="list-style-type: none">• Preferred traits by farmers, consumers and market niches.• Involvement of all value chain stakeholders in promotion processes.• Effective awareness creation through farmer trainings.		

	<ul style="list-style-type: none"> • Backstopping and training impact assessment. • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain • Activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material • Inadequate extension service provision. • Limited investment in research and development of improved planting materials • Perception issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and semi-autotrophic method. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials, such as irrigation facilities. • Provide avenues for capacity building in the value chain through enhanced extension and training • Investing in research work to develop new technologies and innovations. • Work with the immediate leaders of the target farmer groups to ease information transfer.
Lessons learned in up scaling if any	There is need to have pyrethrum germplasm reservoirs in pyrethrum potential areas to preserve planting material


	<ul style="list-style-type: none"> • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Counties need to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain to ease coordination • Provision of information to farmers to enable them to match varieties and clones to the available pyrethrum growing zones
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from Pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services .

	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and the emergence of new players.
Application guidelines for users	<ul style="list-style-type: none"> • KARI information brochure /62/2008 • KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.13 Clone Ks/75/336 (Technology)

2.2.2.13 TIMP Name		Clone Ks/75/336
		
Category (i.e. technology, innovation or management practice)	Technology	
A: Description of the technology, innovation or management practice		
Problem to be addressed	Low pyrethrin content, inadequate pyrethrum flowers production and high susceptibility to abiotic factors.	
What is it? (TIMP description)	Clone Ks/75/336 is high yielder best suited suited for low to medium altitude of upto 1700 masl. It has the potential of producing 1000-1100 Kg of dry flowers/ha/year with a pyrethrin content of 2.0.	
Justification	Clone Ks/75/336 is highly tolerant to extreme temperature conditions and moisture stresses. It also produces good quality of flowers with high pyrethrin content thus it igood for growing in medium altitude of upto 1700 masl.	
B: Assessment of dissemination and scaling up/out approaches		
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators, agripreneurs.	
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer to farmer extension models• Mass media – Electronic and print• Publications -posters/brochures/leaflets, manuals• Digital Platforms– Website, Dashboards, Apps, social media short message services	
Critical/essential factors for successful promotion	<ul style="list-style-type: none">• Preferred traits by farmers, consumers and market niches.• Involvement of all value chain stakeholders in promotion processes.• Effective awareness creation through farmer trainings.	

	<ul style="list-style-type: none"> • Backstopping and training impact assessment. • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain Activities, e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities). • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision. • Limited investment in research and development of improved planting materials. • Perception-related issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Working with the immediate leaders of the target farmer groups to ease the transfer of information • Investment in infrastructure that provides an enabling environment for healthy production of planting materials, such as irrigation facilities • Provide avenues for capacity building across the value chain to enhance extension work including training of trainers. • Investing more in research work to facilitate the development of new technologies and innovations.
Lessons learned in up scaling	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasm reservoirs in


if any	<p>pyrethrum potential areas to preserve planting material</p> <ul style="list-style-type: none"> • Providing planting material in close proximity to farmers is necessary in the up scaling plans. • Counties need to invest more in supporting farmers in pyrethrum value chain in the formative years.
Social, environmental, policy and market conditions necessary for development and up scaling	<p>Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop.</p> <ul style="list-style-type: none"> • The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Ksh Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant

	<p>material.</p> <ul style="list-style-type: none"> • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya. Such areas include: Elgeiyo-Marakwet. This indicates that the crop has an impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased support and incentives by the government, and emergence of new players.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO:Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.2.2.14 Clone Ks/75/313 (Technology)

2.2.2.14 TIMP Name	Clone Ks/75/313
	
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low pyrethrum yield due to high susceptibility to abiotic factors
What is it? (TIMP description)	Clone Ks/75/313 has a potential of producing 1100-1200 Kg of dry flowers/ha/year pyrethrin content of 1.6%. It does well in low to medium altitude of up to 1700 masl.
Justification	Clone Ks/75/313 is a high yielding clone tolerant to extreme temperatures and moisture insufficiency in the soil. It does well in low to medium altitudes produces plenty of flowers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Breeders, Farmers, research service providers, Extension service providers, pyrethrum nursery operators and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches. • Involvement of all value chain stakeholders in promotion processes. • Effective awareness creation through farmer trainings.

	<ul style="list-style-type: none"> • Backstopping and training impact assessment. • Availability, accessibility and affordability of certified seeds, • Good seed system to ensure quality production • Strong partnership linkages, good marketing models and path ways, • Active involvement of public and private agricultural service providers.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies/ Innovations. • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers. • AFA: Formulation of policies for regulation of the value chain activities e.g., nursery establishment. • KEPHIS: Phytosanitary regulation and patenting of materials. • County governments and private extension service: Provision of extension services, regulation of on-farm demonstration, and provision of infrastructure (e.g., driers and irrigation facilities). • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, and Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including: Bomet, Nyandarua, Kakamega and Nakuru.
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate planting material that is outmatched by the demand • Inadequate infrastructure for maintenance and perpetuation of planting material. • Inadequate extension service provision. • Limited investment in research and development of improved planting materials. • Perception-related issues among the target farmer groups.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Campaign for attitude change • Adoption of rapid plant multiplication techniques such as tissue culture and Semi-autotrophic method. • Working with the immediate leaders of the target farmer groups. This will ease the transfer of information. • Investment in infrastructure that provides an enabling environment for healthy production of planting materials. Such infrastructure include: irrigation facility. • Provide avenues for capacity building across the value chain to enhance extension work. This include Training of trainers. • Investing more in research work to necessitate evolution of new technologies and innovations.

Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need to have pyrethrum germplasms reservoirs in pyrethrum potential areas to preserve planting material • Availing material in close proximity to farmers is eminent in the up scaling plans. • There is need to increase revenue allocation to boost the pyrethrum value chain operations.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Through intensive training of farmer groups, the farmers will be persuaded to adopt the crop. • The adoption of the crop will pick especially if complemented with training and backstopping. • Involvement of all the stakeholders in the pyrethrum value chain. This will ensure easy flow of operations. • Provision of information to enable farmers to match varieties and clones to their rightful growing environment.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately 100,000 per acre.
Estimated returns	600 kg per acre per year @ 350 per kg = KES 210,000 Realizable from the second year.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men as household heads dominate most of the production decision-processes which may discourage women from adopting the variety • Women and youth have less access to land which limits them from fully adopting the variety • Women and youths are disadvantaged in their access to other Pyrethrum inputs, such as credit and capital which hinder them from adopting the variety • While women and youth carryout most of the farm activities, revenue from Pyrethrum is controlled by men, limiting women and youth from adoption • The technology may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This disadvantages them on awareness of such new varieties
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities to women and youth to acquire required input such as credit. • Opportunity in marketing for women and youth provides an enabling environment for them to dispose of their produce. • Opportunities in the transport sector for women and youth.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation . • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the

	<p>required inputs such as quality planting materials, manure and fertilizers</p> <ul style="list-style-type: none"> • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • VMG groups to produce and multiply quality/certified plant material. • VMG cottage industries to fabricate and produce flower picking baskets. • At the initial stage of crop development, the uncovered ground offers opportunity for intercrop with short legumes hence increased household income and food security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Emergence of new zones growing pyrethrum in Kenya such as Elgeiyo-Marakwet indicates that the crop has an eminent impact on the socio-economic well-being of the farmers. • The interest of farmers reverting back to this value chain has been made possible by the increased capitation by the government. • Emergence of new players.
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI information brochure /62/2008 2. KALRO Pyrethrum seedlings mobile app-2019
F: Status of TIMP readiness (1-ready for up scaling; 2-requires validation; 3-requires further research)	Requires validation
G. Contacts	
Contacts	<p>1) Centre Director KALRO-Molo (ICRC) P.O. Box 100-20106 Molo Kalro.molo@kalro.org</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420 Nakuru</p>
Lead organization and scientists	KALRO: Robert Kiprotich Lagat, Janet Obanyi, Irene Muriithi, Edward Partet, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

Gaps:

1. Sequencing and screening to check for genetic purity of the existing pyrethrum clones.
2. Breeding to produce new pyrethrum clones.

2.3 SEED SYSTEMS

2.3.1 Tissue Culture Technique for Pyrethrum Seed Systems (Innovation)


2.3.1 TIMPs name	Tissue Culture Technique for Pyrethrum Seed Systems
	
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Unavailability of clean planting materials due to the low number of planting materials produced at a time. The innovation addresses the lack of uniformity in field establishment and maturity.
What is it? (TIMP description)	A rapid multiplication technique for the production of clean (pest and disease free) planting materials. Tissue culture is the growing and multiplication of cells, tissues and organs on defined solid or liquid media under aseptic and controlled environment.
Justification	The primary advantage of micropropagation is the rapid production of high-quality, disease-free and uniform planting material in pyrethrum. Production of high quality and healthy planting material of pyrethrum propagated from vegetative parts has created new opportunities in trading for nursery owners, producers and farmers, and for rural employment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Research institutes, private seed companies, Pyrethrum Processing Company of Kenya (PPCK), extension staff and farmers and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Policy support from government on pyrethrum seed system

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies and Innovations • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	Lack/inadequate knowledge on the benefits of tissue culture seed systems
Suggestions for addressing the challenges	Continuous training of farmers, extension staff and other value chain players on importance of using tissue culture pyrethrum seed.
Lessons learned in up scaling, if any	PPCK has provided pyrethrum TC seed to county nurseries
Social, environmental, policy and market conditions necessary for development and upscaling	Supportive policy of national and county governments to promote adaption of tissue culture seed system in pyrethrum.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on the variety (1acre needs 22,000 splits @ KES 5) = KES110 ,000.00
Estimated returns	Per year 1 acre gives (600kgs of flowers @ KES 210,000.00 by 4 years = KES 630,000.00
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • The innovation is expensive hence women and youths are disadvantaged in their access to inputs, such as credit and capital which hinder them from adopting the innovation • The innovation may not be adopted if the targeted gender, especially women is overburdened with other responsibilities such as the domestic chores • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic chores. This

	disadvantages them on awareness of such innovation
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in establishing nurseries • Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for pyrethrum cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers. • VMGs have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required production resources to engage in pyrethrum cultivation • Opportunities exists for VMGs to perform specialized tasks long the value chain.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Lindilo, C <i>et al</i> (2013). In vitro regeneration of pyrethrum.
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org ; Tel No. +254 722269057</p> <p>2) The Centre Director , KALRO- Njoro P.O. Private Bag,Njoro Email: cd.njoro@kalro.org</p> <p>KALRO Call Centre: 0111010100</p>
Lead organization and scientists	KALRO J. Ndung'u, J.N. Obanyi, I.W. Muriithi K.R. Lagat, C. Imbwaga,

	E.Partet, L.King'ori, L.Wasilwa and V. Kirigua
Partner organizations	MoALD, AFA, County Governments and NGO's, PCPB, PPCK KEPHIS, Universities


2.3.2 Semi Autotrophic Hydroponics in Pyrethrum (Innovation)

2.3.2 TIMPs name	Semi Autotrophic Hydroponics in Pyrethrum
Category (i.e. technology, innovation or management practice)	<p style="text-align: center;">Innovation</p> 
A: Description of the technology, innovation or management practice	
Problem addressed	Unavailability of adequate clean planting materials for the pyrethrum industry
What is it? (TIMP description)	Semi autotrophic hydroponic (SAH) seed system is a rapid technique for pyrethrum planting material multiplication. The technique is carried out in a laboratory and screen house, and involves placing modified soil, plant roots and little water in trays which allows moisture to be transported while keeping the top of soil relatively dry. The SAH technology allows one to produce materials that are entirely free of pests and diseases unlike traditional pyrethrum split methods.
Justification	The SAH technology is suitable for rapid dispersal of improved pyrethrum varieties as it uses simple facilities and requires limited capital investments. Commercial companies and community-based organizations can implement the SAH technique for propagating disease-free high quality pyrethrum planting materials close to the fields where farmers cultivate the crop. This allows seed suppliers to bring early generation planting materials within reach for remote rural communities that rely on pyrethrum for income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All pyrethrum seed systems players including research institutes, private seed companies, extension staff, farmers and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models

	<ul style="list-style-type: none"> • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Policy support from government on favorable pyrethrum seed systems
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies and Innovations • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma, Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	Lack/inadequate knowledge on the benefits SAH systems
Suggestions for addressing the challenges	Continuous training of farmers, extension staff and other value chain players on importance of Semi autotrophic hydroponic systems in pyrethrum
Lessons learned in up scaling, if any	To be determined
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of SAH pyrethrum clones.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	An estimated cost of KES 1,000,000.00 is required to establish a 40 m2 SAH facility
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women and youths are disadvantaged in their access to credit and capital which would hinder them from adopting the innovation. • Women may not have time and mobility to attend extension activities far from home or held at times when they are

	performing other roles e.g. domestic chores. This disadvantages them on awareness of such a innovations
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for learned youths and women exists in setting up SAH nurseries • Affirmative actions on acquisition of credit by women and youths would provide opportunities to establish SAH nurseries
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to information on agricultural technologies and innovations, and to training and extension services • VMGs may also have limited access to finances for investment in a SAH facility • Due to their social status VMGs are often excluded from development and dissemination activities.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action to create opportunities for VMGs to acquire the necessary support to invest in SAH
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Reference: Olugboyega, S. P. <i>et al.</i> (2019). Semi-Autotrophic Hydroponics: A potential seed system technology for reduced breeding cycle and rapid quality seed delivery
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org; Tel No. +254 722269057</p> <p>2) The Centre Director , KALRO- Njoro P.O. Private Bag,Njoro Email: cd.njoro@kalro.org</p> <p><u>KALRO Call Centre 0111010100</u></p>
Lead organization and scientists	KALRO: J. Ndung'u, J.N. Obanyi, I.W. Muriithi K.R. Lagat, C. Imbwaga, E.Partet, L.King'ori, L.Wasilwa and V. Kirigua
Partner organizations s	MoALD, PPCK, AFA, KEPHIS, County governments (Nakuru, Bomet, Kakamega and Nyandarua)

2.3.3 Formal Pyrethrum Seed System (Innovation)


2.3.3 TIMP Name	Formal Pyrethrum Seed System
Category (i.e., technology, innovation or management practice)	<p>Innovation</p> 
A: Description of the technology, innovation or management practice	
Problem addressed	Shortage of clean pyrethrum planting materials.
What is it? (TIMP description)	Production of pyrethrum planting materials from certified seed available from the Pyrethrum Processing Company of Kenya, Nakuru.
Justification	Pyrethrum production can be increased through adoption of the high yielding pyrethrum varieties. This however is faced with the challenge of inadequate supply of quality pyrethrum planting materials. Production of planting materials generated from seed is one way of meeting the demand for planting materials.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, NGOs, pyrethrum nursery operators, extension agents, cooperatives, and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Access to the technology • Sensitization on the technology to the industry stakeholders • Field Demonstration plots

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Involvement of all the industry stakeholders • Pyrethrum farmers organizations – coordination of production, processing and marketing • County governments – Extension, policy and regulation • MoALD, Livestock Development (MoALD)- Extension, policy and funding • Agriculture and Food Authority (AFA) - Regulation and promotion of uptake • KEPHIS - phytosanitary services and certification
C: Current situation and future scaling up	
Counties already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Weak research-extension-farmer linkages in technology delivery • Availability of extension agents to train farmers during pyrethrum cropping calendar
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Strengthen the research-extension-farmer linkage through AIPs • County Governments to avail extension agents to train farmers
Lessons learnt during its promotion, if any	<ul style="list-style-type: none"> • Unscrupulous nursery operators due to shortage of certified pyrethrum seeds have resulted in raising seedlings from uncertified seed and selling them to farmers
Social, environmental, policy and market conditions necessary for up-scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the technology • Environmental conditions will be favourable for establishment of the nurseries • Favorable institutional policy environment • Favorable market prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on the variety (1acre needs 22,000 splits @ KES 3) = KES 66,000.00
Estimated returns	Per year 1 acre gives (600kgs of flowers @ KES 350.00 by 3 years = KES 630,000.00
Gender issues and concerns in dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth have limited access to finances to buy the inputs required to establish nurseries • Women have less access to agricultural information and knowledge on the technology • Women have limited access to training and extension services
Gender-related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit for investment in the nursery enterprises
VMG issues and concerns in dissemination, adoption and	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on the technology

scaling up	<ul style="list-style-type: none"> • VMGs may also have limited access to finances to buy the required inputs to set up the nurseries • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action to create opportunities for VMGs to acquire the necessary support to invest in nurseries establishment
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increase in the number of pyrethrum nurseries operators in the last five years through NGO like Good People International from South Korea in areas such as Subukia in Nakuru County
Application guidelines for users	1. Pyrethrum Propagation Guide book (2019). Kamau J.K, Wycliffe Kiiya, Sammy Ajanga, Nasirembe Wanyonyi, Geoffrey Gathungu, Mabel Mahasi, John Mwangi and Edward Pertet
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org; Phone No: +254722269057</p> <p>2) The Centre Director , KALRO- Njoro P.O. Private Bag,Njoro Email: cd.njoro@kalro.org</p> <p><u>KALRO Call Centre: 0111010100</u></p>
Lead organization and scientists	KALRO: J. Ndung'u, J.N. Obanyi, I.W. Muriithi K.R. Lagat, C. Imbwaga, E.Partet, L.King'ori, L.Wasilwa and V. Kirigua
Partner organizations	MoALD, AFA, PCPB, PPCK, KEPHIS, CoG, NGO's , Universities and County Governments

2.3.4 Formal Seed System - Vegetative propagation through splits (Management Practice)



2.3.4 TIMP Name	Formal Seed System - Vegetative propagation through splits
Category (i.e., technology, innovation or management practice)	Management Practice

			
A: Description of the technology, innovation or management practice			
Problem addressed		Shortage of true-to-type Pyrethrum planting materials	
What is it? (TIMP description)		A formal method of propagating pyrethrum seedlings using plant vegetative splits. The seedlings produced are genetically identical to the mother plant.	
Justification		Vegetative propagation through splits ensures mass production of clean, high quality and true to type of pyrethrum planting materials and adequate supply of planting materials for pyrethrum farmers.	
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP		Farmers, researchers, pyrethrum nursery operators, Extension agents and agripreneurs	
Approaches to be used in dissemination		<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer to farmer extension models• Mass media – Electronic and print• Publications -posters/brochures/leaflets, manuals• Digital Platforms – Website, Dashboards, Apps, social media short message services	
Critical/essential factors for successful promotion		<ul style="list-style-type: none">• Access to the technology• Sensitization on the technology• Availability of field demonstration plots• Enhanced funding for technology dissemination	
Partners/stakeholders for scaling up and their roles		<ul style="list-style-type: none">• Pyrethrum farmers organizations – coordination of production, processing and marketing• County governments – Extension, policy and regulation• MoALD - Extension, policy and funding• Agriculture and Food Authority (AFA) - Regulation and promotion of uptake• KEPHIS - phytosanitary services and certification	

C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in development and dissemination	<ul style="list-style-type: none"> • Weak research-extension-farmer linkages in technology delivery • Availability of extension agents to train farmers during pyrethrum cropping calendar
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Strengthen the research-extension-farmer linkage through AIPs • County Governments to avail extension agents to train farmers
Lessons learnt during its promotion, if any	Partnering with County governments and other stakeholders has enhanced the dissemination of the technology Technical backstopping on the suitability of the various pyrethrum varieties to different agro ecological zones enhances the uptake of pyrethrum planting materials
Social, environmental, policy and market conditions necessary for up-scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the technology • Favorable agro-ecological conditions • Favorable institutional policy environment • Favorable market prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on the variety (1 acre needs 22,000 splits @ KES 3) = KES 66,000.00
Estimated returns	Per year 1 acre gives (600kgs of flowers @ KES 350.000 by 3 years = KES 630,000.00
Gender issues and concerns in dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth have limited access to finances to buy the inputs required to establish nurseries • Women have less access to agricultural information and knowledge on technology due to limited access to training and extension services
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit for investment in nursery enterprises
VMG issues and concerns in dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on the technology • VMGs may also have limited access to finances to buy the required inputs to set up the nurseries • VMGs have limited access to training and extension services • due to their social status VMGs are often excluded from development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action to create opportunities for VMGs to acquire the necessary support to invest in nurseries' establishment
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Pyrethrum producing counties through their county governments have distributed millions of pyrethrum split seed to farmers.

Application guidelines for users	1. Pyrethrum Propagation Guide book (2019). Kamau J.K, Wycliffe Kiiya, Sammy Ajanga, Nasirembe Wanyonyi, Geoffrey Gathungu, Mabel Mahasi, John Mwangi and Edward Pertet
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director , KALRO Molo P.O. Box 100-20106 MOLO Email: kalro.molo@kalro.org ; 2) The Centre Director , KALRO- Njoro P.O. Private Bag,Njoro Email: cd.njoro@kalro.org <u>KALRO Call Centre: 0111010100</u>
Lead organization and scientists	KALRO: J. Ndung'u, J.N. Obanyi, I.W. Muriithi K.R. Lagat, C. Imbwaga, E.Partet, L.King'ori, L.Wasilwa and V. Kirigua
Partner organizations	MoALD, AFA, PCPB, PPCK, KEPHIS, CoG, NGO's , Universities and County Governments

2.3.5 Nursery Management (Management practice)

2.3.5 TIMP Name		Nursery Management	
Category (i.e. technology, innovation or management practice)		Management Practice	
			
		<i>Figure 1. Pyrethrum seed propagation nurseries</i>	
A: Description of the technology, innovation or management practice			
Problem to be addressed		Low yields due to planting of unimproved pyrethrum varieties.	
What is it? (TIMP description)		Nursery management is the sum of the activities performed for the successful production, care, and marketing of planting materials (seeds, seedlings, cuttings, etc.). Its purpose is to avail adequate supply of true-to-type, pest and disease-free planting materials All pyrethrum seed nurseries should be certified by KEPHIS and	

	Licensed by AFA. This process involves a systematic evaluation of the Nursery's compliance with the requirements for domestic and/ or international movement of nursery stock
Justification	Lack of adequate true-to-type, high quality, pest and disease-free planting material has proven to be a challenge to optimization of pyrethrum yields. Farmers have planted materials susceptible to pests and diseases and are also of low quality, due to lack inadequate material. This low pyrethrum flower yields have resulted in slow increase in number of farmers as well as slow increase in land under pyrethrum production in Kenya. In this regard, establishment of nurseries that are regulated under set policies is key as it ensures that farmers are able to access high quality planting material in enough quantities to meet demand.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum farmers, researchers, Extension staff, processors and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Good seed system to ensure quality and availability • Organized farmer groups or common interest groups (CIGs) • Availability of Extension services • County and National government support • Funding for dissemination of the practice.
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> • KALRO: Research and development of technologies and Innovations • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g. driers and irrigation facilities) • Nursery operators: Establishment of nurseries and supply of planting materials to farmers.

	<ul style="list-style-type: none"> • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up scaled	Nakuru, Uasin Gishu, Elgeyo Marakwet, Nandi, Baringo, Kericho, Bomet, Narok, Laikipia, Trans Nzoia, West Pokot, Kisii, Nyamira Kiambu, Nyeri, Nyandarua; Meru, Embu, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate extension officers for effective training farmers on appropriate methods of nursery management • Reluctance of nursery operators to adopt the Practice.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Enhance Public Private Partnerships (PPP) to support increased adoption • Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of beneficial parts of the management practice.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need for capacity building of nursery operators on the TIMP.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Nursery establishment will be socially acceptable (particularly to the women and youth who form the labour force in pyrethrum production) in the target communities. • There will be available labour for establishing and managing the nurseries • Environmental conditions will be favourable for crop growth during upscaling activities for nursery management. • Policy environment will be enabling for upscaling of the nurseries • The market will be willing and able to absorb the extra produce arising from the increased yields.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women have less access to land - so they have to rely on their husbands to select and apportion land for pyrethrum cultivation • Women have less access to agricultural information, technology and knowledge . • Women and youth have less access to credit to purchase the required inputs. • Women have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action fund opportunities such as the women and youth enterprise fund exist for them to access the required finances
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land to practice crop rotation. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from Decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness. VMG have

	less access to extension training <ul style="list-style-type: none"> • VMG have less access to knowledge and information on land preparation
VMG related opportunities	<ul style="list-style-type: none"> • Opportunity exist for women to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Trials have demonstrated that improved varieties performed significantly better than unimproved materials.
Application guidelines for users	1. Pyrethrum Board of Kenya (1992). Recommendations arising from Agronomic Research and other Sources in Kenya. Pyrethrum Growers Handbook, Pyrethrum Board of Kenya, Nakuru, Kenya.
F: Status of TIMP readiness (1-ready for up scaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	1) 1) The Centre Director KALRO molo P.O Box 100, 20106 Molo 2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru
Lead organization and scientists	KALRO J. Ndung'u, J.N. Obanyi, I.W. Muriithi K.R. Lagat, C. Imbwaga, E.Partet, L.King'ori, L.Wasilwa and V. Kirigua
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSME

Gaps:

There is need for development and validation of pyrethrum mechanical planters

2.4 FOOD SAFETY MANAGEMENT SYSTEMS

2.4.1 Good Agricultural Practices (GAPs) for Pyrethrum (Management practice)

2.4.1 TIMPs name	Good Agricultural Practices (GAPs) for Pyrethrum
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Loss of quality due to adulteration of Pyrethrin content resulting from over use or indiscriminate use of some agricultural pesticides or chemicals derivatives during pyrethrum growth and flowers production.
What is it? (TIMP description)	GAP use in pyrethrum flower production is a systematic

	process of implementing a standardized production system designed to enable producers in realizing optimum pyrethrum yields and quality for unadulterated safe, pyrethrin content for value added products, farm handlers and the environment through standardized methods pests and weeds control at farm level.
Justification	Some active chemical ingredients found in pesticides can alter the effectiveness and safety of the final pyrethrin content. Since GAP is based on the principles of risk prevention and analysis, it is important to note the chemicals that will adulterate the pyrethrin content alongside increasing the risks of its exposure to its end-use products to consumers. GAP ensures the elimination of this risk from the pyrethrum value chain
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All pyrethrum value chain players including producers, extension staff, processors, market outlet operators including wholesale and retail chains, domestic markets, farm gate handlers and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	Policy support from government on safe use of pest control products (PCP's) on pyrethrum value chain.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO: Research and development of technologies and Innovations • Pyrethrum Processing Company of Kenya (PPCK): Processing of pyrethrum and multiplication of planting materials to supply to farmers • AFA: Formulation of policies for regulation of the value chain activities, e.g., nursery establishment • KEPHIS: Phytosanitary regulation and patenting of materials • County governments and private extension service: Provision of extension services, regulation of on-farm demonstrations, and provision of infrastructure (e.g., driers and irrigation facilities)

	<ul style="list-style-type: none"> • Nursery operators: Establishment of nurseries and supply of • planting materials to farmers. • Willing farmers in target areas: Adoption of varieties
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Meru, Meru, Bomet, Nyandarua, Nyeri and Kiambu
Counties where TIMP will be up scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> • Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAPs, in particular the domestic scope • The perception that GAPs is oppressive rather than supportive
Suggestions for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	The low number of stakeholders aware of GAPs
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on GAPs . • Women have limited access to education, training and extension services on GAPs • Most small scales production systems are centered on women and hence it's them who suffer from the detriments of poor practices. • The improper application of pesticides results in more women suffering from complications in small scale holdings. This means that adaption of GAPs will increase the benefits of good health to the women and those who work more on the farm.
Gender related opportunities	<ul style="list-style-type: none"> • Due to the systematic method of the process, employment opportunities exist for youths in performing the task of GAPs • Proper application of GAPs will lead to improved health of the various gender categories due to consumption of clean health pyrethrum that is free from hazards
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled. • VMGs have limited access to education, training and extension services on GAPs .

	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on GAPs . • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youths exist in performing the task of GAPs • Proper application of GAPs will lead to improved health of the various gender categories due to consumption of clean health pyrethrum that is free from hazards. • There will be enhanced productivity of smaller parcels of land to the advantage of youth who normally have no access to larger parcels.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Not yet
Application guidelines for users	<ol style="list-style-type: none"> 1. Options for certification exist depending on whether it is a single holder certification or group compliance. 2. Compliance is a process and hence takes time and involves a process of continuous improvement. 3. No need for farm sophistication to adopt. 4. There is provision for taking corrective action for all noncompliance at time of assessment. 5. Requires continuous training and exposure to better systems.
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director , KALRO- Njoro P.O. Private Bag,Njoro KALRO Call Centre: 0111010100</p>
Lead organization and scientists	KALRO: Ndung'u, J.N., Nyagah, A., Obanyi, J., Muriithi, I.W., Lagat, R.K., Wasilwa, L. and Kirigua, V.
Partner organizations and their roles	MoALD, AFA, PPCK, PCPB, KEPHIS, CoG, NGO's and Universities.

2.4.2 Product Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Pyrethrum Value Chain in Kenya (Management Practice)

2.4.2 TIMP Name	Product Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Pyrethrum Value Chain in Kenya
Category (i.e technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of incidence and exposure to pesticide and chemical hazards to pyrethrin product during pyrethrum flower production and post-harvest handling.
What is it? (TIMP description)	Product safety management system (PSMS) through Hazard Analysis and Critical Control Point (HACCP) in pyrethrum. It is a system of ensuring pyrethrin safety through monitoring and standardized control based on a systematic identification and assessment of various hazards during pyrethrum flower production. PSMS is a preventive, rather than a reactive tool that secures pyrethrin supply from biological, chemical and physical hazards during flower production. The HACCP system is designed to minimize the risk of pyrethrum flower safety hazards by identifying them, establishing controls and monitoring these controls.
Justification	The only important tool kit to assure safety through monitoring in the pyrethrum flower 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. This HACCP approach can be applied to all stages of the pyrethrum value chain process, ranging from production to processing, transportation and retail in commercial establishments. Through its application, crop production safety charts in the pyrethrum 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 pyrethrum value chain, the proposed FSMS if adopted will minimize hazards in every phase of production, harvesting, processing and distribution making pyrethrum safe for production and use by Kenyans.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum value chain actors from farmers, traders, and agripreneurs.
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents

	<ul style="list-style-type: none"> • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • An expert team composed of HACCP specialist, food scientist, microbiologist, representative of the pyrethrum growers, public health officer, and a quality control and safety specialist from the Kenya Bureau of Standards. • Distribution of the printed HACCP plan to pyrethrum value chain actors for implementation in order to reduce hazards.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • Institutions with IPM and ICM programs • Institutions responsible for legislating in food safety, regulations and sale of pesticides • Institutions with the required analytical testing • Training institutions with extension programs to producers and other actors on the chain • Producers and exporters associations. • Universities (Public and Private) • Processors and local traders
C: Current situation and future scaling up	
Counties where already promoted. if any	Not promoted in any county of Kenya
Counties where TIMPs will be up scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties growing and processing pyrethrum in Kenya.
Challenges in development and dissemination	Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	Funding of dissemination platforms
Lessons learned in up scaling, if any	The value chain of pyrethrum in Kenya is willing to adopt the HACCP plan if well engaged.
Social, environmental, policy and market conditions necessary for development and up-scaling	The policies and laws in public health in place in Kenya are supportive to the use of HACCP Plan in pyrethrum value chain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on HACCP . • Women have limited access to education, training and extension

	<p>services on HACCP</p> <ul style="list-style-type: none"> • Most small-scale production systems are centered on women and hence it's them who suffer from the detriments of poor practices. The improper application of pesticides results in more women suffering from complications in small scale holdings. This means that adaption of GAPs will increase the benefits of good health to the women and those who work more on the farm.
Gender related opportunities	<ul style="list-style-type: none"> • Due to the systematic methods and processes of employment opportunities exist for youths in performing the task of HACCP • Proper application of HACCP will lead to improved health of the various gender categories due to consumption of clean healthy pyrethrum that is free from hazards
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled. • VMGs have limited access to education, training and extension services on HACCP . • VMGs have less access to agricultural information, technology and knowledge on HACCP . • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youths exist in performing the task of HACCP • Proper application of HACCP will lead to improved health of the various gender categories due to consumption of clean health pyrethrum that is free from hazards. • There will be enhanced productivity of smaller parcels of land to the advantage of youth who normally have no access to larger parcels.
E: Case studies/profiles of success stories	
Success stories	Not done
Application guidelines for users	Not done
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo, P.O Box 100-20106 – MOLO, Email: kalro.molo@kalro.org</p> <p>2) The Centre Director , KALRO- Njoro, P.O. Private Bag, Njoro</p>

	KALRO Call Centre: 0111010100
Lead organization and scientists	KALRO: Ndung'u, J.N., Obanyi, J., Nyagah, A., Muriithi, I.W., Lagat, R.K., Wasilwa, L. and Kirigua, V.
Partner organizations and their roles	MoALD, AFA, PCPB, PPCK, KEPHIS, CoG, NGO's, Universities and County Governments

2.5 AGRONOMIC MANAGEMENT PRACTICES

2.5.1 Site Selection (Management practice)


2.5.1 TIMP Name	Site Selection
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low pyrethrum productivity associated with planting pyrethrum in unsuitable environments.
What is it? (TIMP description)	<p>This is the identification and selection of the location and site to plant the pyrethrum crop.</p> <p>The site should lie within 1700 -3000m above the sea level, have rainfall of not less at least 750mm, well distributed throughout the growing period and 1000-1125mm in warmer areas where evaporation is high. Temperatures should be cool, and of less than 18°C for at least 6 weeks, in order to initiate flowering.</p> <p>The soils should be deep, free from water logging, fertile and rich in Calcium, Phosphorus and Magnesium with a pH of 5.0-6.5. The land should not have been under pyrethrum for 3-6years.</p> <p>Parameters for site suitability for pyrethrum are soil (pH, drainage, texture, and nutrients), climate (temperature and rainfall), and topography (slope and elevation).</p>
Justification	The optimum yields and quality attained by pyrethrum varieties and clones vary with clone/variety and environment. To attain the maximum pyrethrin and yield benefit from a pyrethrum clone/variety it should be planted in the most appropriate environment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum farmers, researchers, Extension staff and processors, seed stockists and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals

	<ul style="list-style-type: none"> Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organized farmer groups or common interest groups (CIGs) Availability of Extension services <ul style="list-style-type: none"> County and central government support Adequate funding
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> Organized farmer groups or Common Interest Groups (CIGs) to mobilizing farmers Availability of extension services to train and create awareness about land selection County and National Governments to fund and promote the practice. Pyrethrum processors to disseminate the practice to contracted farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> Inadequate extension officers for effective farmer training Willingness of farmers to adopt the Practice.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Enhance Public Private Partnerships (PPP) to support increased adoption Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of beneficial parts of the management practice.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> There is need for continuous farmer trainings on proper selection
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> There are no social issues that would hinder development and up scaling on this Practice. Policy's that govern pyrethrum production are in place. There are no Environmental concerns
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N/a
Estimated returns	210,000/= per acre per year (value of flowers produced)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women have less access to land - so they have to rely on their husbands to select and apportion land for pyrethrum cultivation Women have less access to agricultural information, technology and knowledge . Women and youth have less access to credit to purchase the required inputs. Women have limited access to education, training and extension services .

Gender related opportunities	<ul style="list-style-type: none"> Affirmative action fund opportunities such as the women and youth enterprise fund exist for them to access the required finances
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMG have less access to extension training Lack of participation by some VMGs in decision making hence may not benefit from the project VMGs have financial constraints so they are not able to purchase land. Limited access to production resources such as land, knowledge and information. Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> Opportunity exist for women to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> Growers who practice proper land selection have well established crop.
Application guidelines for users	Pyrethrum Board of Kenya (1992). Recommendations arising from Agronomic Research and other Sources in Kenya. Pyrethrum Growers Handbook, Pyrethrum Board of Kenya, Nakuru, Kenya.
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	1) The Centre Director KALRO- Molo P.O Box 100, 20106 Molo 2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru
Lead organization and scientists	Kenya Agriculture Livestock and Research Organization Irene Muriithi, Janet Obanyi, Edward Pertet ,Robert Lagat, Lewis King'ori, Lusike Wasilwa,Violet Kirigua
Partner organizations	PPCK,County Governments, AFA, KEPHIS, MSME

2.5.2 Land Preparation (Management Practice)

2.5.2 TIMP Name	Land Preparation
Category (i.e. technology, innovation or management practice)	Management Practice

	 <p><i>Land ploughing using a tractor (source Mokaya Dominic KALRO Molo)</i></p>  <p><i>Land harrowing using a tractor</i></p>
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low pyrethrum yields associated with poor land preparation.
What is it? (TIMP description)	<p><u>Land Preparation</u></p> <p>This is the clearing and tilling of fallow fields or stubble from previous harvest in good time, in readiness for planting. The purpose is to provide necessary soil conditions for the successful establishment of seeds or seedlings. It also aims at controlling perennial weeds that are difficult to eradicate later without destroying the established crop. Ploughing should be deep enough to allow deep root growth and establishment, and facilitate water infiltration.</p> <p>Land preparation may involve use of herbicides against perennial weeds, and ploughing the land during dry months helps to destroy stubborn weeds. Tilling may be done using hoes/jembes for small scale farming and a tractor or animal drawn equipment, for large scale farming. It may also involve more than one soil working operation to attain the desired soil tilth and recommended depth.</p>
Justification	Improper land preparation leads to poor crop establishment due to poor root growth leading to poor flower yield. Proper and timely

	land preparation ensures good crop establishment at the appropriate time for realization of high yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum farmers, researchers, Extension staff, processors and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Access to affordable soil testing services • Organized farmer groups or common interest groups (CIGs) • Availability of Extension services • County and National government support • Subsidized cost of tractor hire and reduced cost of purchasing equipment.
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> • Organized farmer groups, cooperative or Common Interest Groups (CIGs) • to mobilise farmers • Availability of extension services to train and create awareness • about land preparation • County and National Governments to fund and promote the practice. • County Governments to avail necessary farm implements • at subsidized prices • Pyrethrum processors to disseminate the practice to contracted farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced

Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate extension officers for effective training farmers on • appropriate methods of land preparation
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Enhance Public Private Partnerships (PPP) to support increased dissemination activities • Employ extension to reach more farmers
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is need for continuous farmer trainings on proper land preparation practices.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Land preparation practices will be socially acceptable (particularly to the women and youth who form the labour force in pyrethrum production) in the target communities. • Labour will be available for implementation of the TIMP • Environmental conditions will be favourable for crop growth during upscaling activities for land preparation. • Policy environment will be enabling for upscaling of the TIMP • The market will be willing and able to absorb the extra produce arising from the increased yields.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of one Ploughing KES5,000 cost of one Harrowing KES2,500 $5000 + 2,500 = \text{KES } 7,500$ per acre
Estimated returns	KES 210,000 (gross value of annual flower yield)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men perform most of the land preparation tasks therefore the TIMP may not be adopted if they are engaged in other activities. • Women have less access to land - so they have to rely on their husbands to select and apportion land for pyrethrum cultivation • Women have less access to agricultural information, technology and knowledge . • Women and youth have less access to credit to purchase the required inputs. • Women have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action fund opportunities such as the women and youth enterprise fund exist for them to access the required finances • Youth have opportunities in land preparation and use of farm implements
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMG have less access to extension training • VMG have less access to knowledge and information on land preparation • Some VGM may be challenged in adoption of the TIMP as it


	is labor intensive
VMG related opportunities	<ul style="list-style-type: none"> Opportunity exist for women to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> Growers who practice timely and good land preparation have well established crop and subsequent effective weed management.
Application guidelines for users	Pyrethrum Board of Kenya (1992). Recommendations arising from Agronomic Research and other Sources in Kenya. Pyrethrum Growers Handbook, Pyrethrum Board of Kenya, Nakuru, Kenya.
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3- requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) 1) The Centre Director KALRO - Molo P.O Box 100 - 20106 Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru</p>
Lead organization and scientists	Kenya Agriculture Livestock and Research Organization Irene Muriithi, Janet Obanyi, Edward Pertet ,Robert Lagat, Lewis King'ori, Lusike Wasilwa,Violet Kirigua
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSMEs

Gaps:

There is need for development and validation of pyrethrum mechanical planters

2.5.3 Planting, Plant Population, and Spacing (Management Practice)

2.5.3 TIMPs name	Planting, Plant Population and Spacing
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	<ul style="list-style-type: none"> Low flower yields Low pyrethrin Content Sub optimal land resource utilization
What is it? (TIMP description)	<p>Pyrethrum Planting</p> <p>This is the establishment of the pyrethrum crop at the appropriate</p>

	<p>time and in the appropriate manner so as to maximize the utilization of the environment resources such as rainfall, temperatures, and soil space.</p>  <p><i>An established pyrethrum field at PPCK nursery, photo courtesy of Carolyn Imbwaga</i></p>
Justification	<p>Early planting, at the onset of long rains is recommended for pyrethrum, since late planting leads to poor establishment and poor yields in the first year, although subsequent yields are unaffected. Planting at the optimum plant density ensures optimal use of soil nutrients and moisture, while minimising inter plant competition which leads to reduction of yields. Thus recommended planting density is lower in the drier areas than the wetter areas.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, PPCK, Processors, Dealers, Research institutions and universities, Regulators and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of quality planting material (seed and vegetative) • Accessibility and affordability of seed • Strong linkage among pyrethrum growers value chain actors • Strong partnership linkages • Awareness campaigns
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Public and private extension service providers- To help in the technology dissemination • NGOs: –Partner in technology dissemination through onfarm

	<p>demonstrations</p> <ul style="list-style-type: none"> • Seed companies –Agri-business and marketing of the technology • Processors – Market for the dry flowers and incentives to growers • Educational institutions- Providing the information • County governments –Assist in the dissemination of the technology, Linking farmers to processors
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Nyandarua, Kericho, West Poket
Counties where TIMP will be upscaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate number of extension agents • Inadequate funds for dissemination activities and materials
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Engage and capacity build extension agents • Prioritize and allocate funds for dissemination activities
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Information dissemination of climate smart agriculture - Participation of producers in on-farm activities/extension activities - Promoting awareness among farmers on the importance of climate smart agronomic practices for improved crop productivity • Alternative method (mechanization - planter) may lessen the work. Capacity building and awareness campaign on climate smart agronomic practices is required
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Value chain is socially acceptable - Conducive environment for pyrethrum production • Ability of market to absorb increased productivity • Supportive frameworks and policies are available and need to be enforced
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	No extra costs
Estimated returns	KES 170,000-250,000/= per acre/year actual returns depend on yields realized
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women have limited access to production resources such as land, knowledge, information, extension training, and credit and quality seed. • Women have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in development, dissemination, adoption	<ul style="list-style-type: none"> • VMGs have limited access to production resources such as land, knowledge, information, extension training, and credit


and scaling up	<p>and quality seed.</p> <ul style="list-style-type: none"> • VMGs have limited access to education, training and extension services . • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit
E: Case studies/profiles of success stories	
Success stories from previous similar projects	N/A
Application guidelines for users	Pyrethrum Growers Manual
F: Status of TIMP readiness (1-ready for up scaling; 2-requires validation; 3-requires further research)	<p>Ready for upscaling</p> <p>To be validated in new areas being opened up</p> <p>Further research on technologies on planting</p> <p>Development of new technologies</p>
G: Contacts	
Contacts	<p>1) The Centre Director KALRO - Molo P.O Box 100 - 20106 Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru</p>
Lead organization and scientists	Kenya Agriculture Livestock and Research Organization Irene Muriithi, Janet Obanyi, Edward Pertet, Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	Pyrethrum Processing Company of Kenya, County Governments, AFA, KEPHIS, NGOs

References

1. Pyrethrum Growers Manual 2nd Edition WGM Ottaro
2. Pyrethrum Growers Manual 3rd Edition Agriculture and Food Authority 2019

2.5.4 Weeding (Management practice)

2.5.4 TIMP Name	Weeding
Category (i.e. technology, innovation or management practice)	Management Practice

	 <p style="text-align: center;"><i>Good weed management</i></p>
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low flower yield due to competition with weeds
What is it? (TIMP description)	Weeding is the removal of unwanted/undesired plants from the field, either manually or by use of herbicides. Pyrethrum fields should be kept weed-free at all times. It is recommended to weed at 4-week intervals for good pyrethrum establishment. In more fertile areas with heavy rainfall, additional weeding may be required since weeds establish faster.
Justification	Lack of weeding can result in a reduction of flower yield by more than 50% due to competition for moisture and nutrients as well as the introduction of pests and diseases. Pyrethrum plants grow very slowly compared to most weeds and barely cover the soil completely. Weeds compete with pyrethrum for space, nutrients, light and space. In addition weeds are alternative hosts for pests and diseases. The ecological requirements of pyrethrum favor the growth of many weeds; therefore they are a constant hazard and should be suppressed completely. Timely weeding leads to enhanced yields by enabling the crop to realise its full genetic potential.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum farmers, researchers, Processors, Extension staff and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals

	<ul style="list-style-type: none"> Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organized farmer groups or common interest groups (CIGs) Availability of Extension services County and National government support Adequate Funding
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> Organized farmer groups or Common Interest Groups (CIGs); to promote appropriate weeding practice. Availability of extension services to train and create awareness about weeding County and National Governments to fund and promote the practice. County Governments to avail necessary farm implements at subsidized prices. Pyrethrum processors to mobilize farmers and extension services.
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up Scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> Farmer perception towards pyrethrum crops Inadequate funds for demonstration
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Enhance Public Private Partnerships (PPP) to support increased adoption Create or use technology dissemination channels like farmer groups, Farmers Field and Business schools, AIPs, digital platforms Source for funding
Lessons learned in up scaling if any	<ul style="list-style-type: none"> Development and Adaption of user-friendly mechanized weeders will reduce the cost of weeding thus increasing pyrethrum yields. Capacity building public and private agricultural extension service providers with information on weed management in pyrethrum production is key to successful upscaling and adoption of the practice
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Enabling policies by county and National governments to support weeding methods and practices Willingness of stakeholders to participate Farmers are willing to adopt the TIMP There are no environmental concerns
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	15 man-days x 1 acre x 527/= x 9 weeding cycles/year = 71,145
Estimated returns	KES 210,000- 71,145= KES 138,855 (less weeding costs only)



Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women may have less access to credit to purchase the required implements. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunity exist for women to access credit through the women enterprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Older famers may not be able to weed effectively. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youth to access the required credit.
E: Case studies/profiles of success stories	
Success stories if any	
Application guidelines for users	<ol style="list-style-type: none"> 1. Pyrethrum growers Manual 2021 2. Pyrethrum Compendium, Janet Obanyi 2022
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3-requires further research)	Ready for up scaling
G. Contacts	
Contacts	<p>1) The Centre Director KALRO Molo P.O Box 100, 20106 Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru</p>
Lead organization and scientists	KALRO Irene Muriithi, Janet Obanyi, Edward Pertet ,Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSME

Gaps:

Manual weeding is labour intensive hence the need for development of a chemical herbicide that is suitable for pyrethrum farming

2.5.5 Fertilizer and manure application at planting (Management Practice)

2.5.5 TIMP Name	Fertilizer and manure application at planting
Category (i.e. technology, innovation or management practice)	Management Practice

	  <p><i>Triple superphosphate fertilizer Farm yard manure</i></p>
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields due to declining soil fertility, low organic matter, poor soil structure and limited available moisture in crop production.
What is it? (TIMP description)	<p>This is the application of plant nutrients from inorganic or organic sources to soils to enhance productivity.</p> <p>Inorganic Phosphate fertilizers are recommended for use in pyrethrum growing as they promotes flower production. These are applied at planting</p> <p>Organic Farmyard Manure (FYM) can be obtained from different animals (poultry, cow, goat,) on the farm, but it can also be purchased from other farmers or at the market. When managed properly, it provides plant nutrients, builds soil organic matter, and improves soil physical properties.</p>
Justification	The decline in soil fertility in smallholder system is a major factor limiting pyrethrum crop yields. The decline in soil fertility is compounded by leaching of applied nutrients, soil erosion and continuous cultivation and crop harvest without adequate nutrient replenishment. There is significant flower yield when Triple superphosphate (T.S.P) fertilizer is applied during planting.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Pyrethrum farmers, Researchers, Processors, Agro-input suppliers, Extension staff and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals Digital Platforms – Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organized farmer groups or common interest groups (CIGs) Training on fertilizer and manure use Dissemination approach used to reach target farmers Availability of affordable and quality fertilizers Take into account variability between farms and soil, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; Take into account amount of production that different farming families are able to invest in
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> Organized Pyrethrum farmer groups or Common Interest Groups (CIGs) to promote the TIMP Availability of extension services to train and create awareness On fertilizer use. County and National Governments to fund and promote the practice. County Governments to avail subsidized fertilizer Pyrethrum processors to mobilize farmers Fertilizer manufacturing companies for fertilizer production
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up Scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	Weak research-extension-farmer linkages in TIMP delivery
Suggestions for addressing the challenges	Strengthen the research-extension-farmer linkage
Lessons learned in up scaling if any	Fertiliser is crucial for enhancing of pyrethrum yields
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Farmers' willingness to adopt the practice Favorable institutional policy environment Favorable market prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 7,000/= (50kg bag/1 acre) This is subject to soil test results, for soils with very low phosphorus levels, 1.5 50 kg bags will be needed.
Estimated returns	KES 150,000/acre/year
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women and youth may also have limited access to finances to buy the required fertilizer and manure to implement the technology . Women have less access to agricultural information, technology and knowledge on the technology . Women have limited access to education, training and extension services
Gender related opportunities	<ul style="list-style-type: none"> Affirmative action opportunities exist for women and youths

	to acquire the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on the practice . • VMGs may also have limited access to finances to buy the manure and fertilizers . • VMGs have limited access to education, training and extension services . • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Farmers in Nakuru county who received subsidized fertilizer and applied it during planting at the recommended rates recorded high flower production levels.
Application guidelines for users	<ol style="list-style-type: none"> 1. KALRO Pyrethrum Propagation manual 2019 2. AFA Pyrethrum Growers Manual 3rd Edition 2019
F: Status of TIMP readiness (1- ready for up scaling;, 2- requires validation; 3-requires further research)	Requires validation
G. Contacts	
Contacts	<p>1) The Centre Director KALRO Molo P.O. Box 100, 20106 Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru</p>
Lead organization and scientists	<p>KALRO Irene Muriithi, Janet Obanyi, Edward Pertet ,Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua</p>
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSME

2.5.6 Top Dressing Fertilizer (Management Practice)

2.5.6 TIMP Name	Top Dressing Fertilizer
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	

Problem to be addressed	Reduced yields caused by low soil fertility due to land degradation
What is it? (TIMP description)	Top dressing is an application of manure or inorganic fertilizer to the surface layer of soil. It is done after the crop has established and is aimed at benefiting the crop by enhancing its productivity.
Justification	Soils in most pyrethrum growing areas have either been degraded or have low inherent fertility leading to low crop yields. Many farmers use fertilizer amounts below the recommended fertilizer rates per unit area due to limited resources. This implies that farmers do not exploit the full potential of the pyrethrum variety/clone they choose. Application of the recommended inorganic fertilizers enriched with locally available organic fertilizers significantly enhances pyrethrum yields by unlocking yield potential of recommended varieties/ clones
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Pyrethrum farmers, researchers, processors, extension staff, and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Applied and adaptive research to test, validate fertilizer types and application rates in different agro ecological zones A platform for interaction of value chain stakeholders especially researchers', agricultural service providers input stockists and farmers Willing farmers to adopt the management practices Implementation of Farmer Field and Business School (FFBS) strategy Well organized farmer groups and networks to ease dissemination Active involvement of public and private agricultural service providers during dissemination and ToT training sessions Availability of inputs
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> Organized farmer groups or Common Interest Groups (CIGs) to promote appropriate weeding practice Availability of extension services to train and create awareness on the management practice County and National governments to fund and promote the




	<p>practice.</p> <ul style="list-style-type: none"> County governments to provide necessary farm implements At subsidized prices. Pyrethrum processors to mobilize farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up Scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> Resources- poor farmers may not have the ability to invest on inorganic fertilizers because of high cost. The myth that inorganic fertilizers make the soil hard to manage. Disorganized farmer groups to ease dissemination of information. Limited information by farmers and agricultural extension service providers (public and private) on the importance of inorganic and organic fertilizers in pyrethrum production
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Provision of credit to purchase inorganic fertilizer and subsidizing input prices by the County governments. Constitute innovation platform to facilitate interaction of farmers with relevant stakeholders for information sharing through field days, workshops and trainings. Enhance capacity of farmers through awareness and sensitization campaigns and workshops on merits of fertilizer use to flower yields Capacity build public and private agricultural extension service providers with information on recommended inorganic fertilizer rates Form CIGs to ease dissemination of information
Lessons learnt in up scaling if any	N/A
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> The practice is socially acceptable as it would add to household incomes The practice has as no negative impacts to the environment if used within the recommended rates Market will absorb the increased productivity Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women have less access to land - so they have to rely on men to select and allocate how land will be used. Women have less access to agricultural information, technology

	<p>and knowledge .</p> <ul style="list-style-type: none"> • Women and youth have less access to credit to purchase the required inputs. • Women have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action fund opportunities such as the women and youth enterprise fund exist for them to access the required finances • Youth have opportunities in top dressing as it is not labour intensive.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land to practice top dressing • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from • Decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunity exists for women to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	N/A
Application guidelines for users	To be developed
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3-requires further research)	Requires further research
G. Contacts	
Contacts	<p>1) The Centre Director KALRO Molo P.O Box 100, 20106 Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru</p>
Lead organization and scientists	Kenya Agriculture Livestock and Research Organization Irene Muriithi, Janet Obanyi, Carolyn Imbwaga, Edward Pertet ,Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	PPCK, County governments, AFA, KEPHIS, MSME

Gaps:

Further research is needed to validate the use of top dressing and its effect of pyrethrum flower production

2.5.7 Flower picking (Management practice)


2.5.7 TIMP Name	Flower picking
Category (i.e. technology, innovation or management practice)	<p>Management Practice</p>  <p><i>Developmental stages of pyrethrum flowers.</i></p>
A: Description of the technology, innovation or management practice	
Problem to be addressed	Decline in flower pyrethrin content due to wrong picking practices.
What is it? (TIMP description)	<p>The most important factor in pyrethrum production is the quantity of pyrethrins harvested per unit area. Pyrethrum flowers contain 92% of the pyrethrin content and is highly influenced by the flower development stage at which the flower is picked. Pyrethrin content is at its maximum when the ray florets are horizontal and 3-4 rows of disc florets are open to ensure maximum pyrethrum levels.</p> <div style="text-align: center;">  </div> <p>This is the ideal stage for flower picking. Young flowers contain low pyrethrins and if picked in high quantities will lower the pyrethrin content.</p> <p>Correct picking interval is every 2 weeks, this will reduce the number overblown flowers left on the plant as they reduce the number of newly initiated buds.</p> 

	<p>The best picking is achieved by holding the flower between the 1st and 2nd finger and jerking the flower head with the thumb.</p> <p>Avoid flower harvesting under rainy conditions to prevent fermentation resulting in losses of pyrethrins.</p>
Justification	<p>The most important factor in pyrethrum production is the quantity of pyrethrins harvested per unit area. Pyrethrum flowers contain 92% of the pyrethrin content and is highly influenced by the flower development stage at which the flower is picked. To maximize production, flowers have to be picked only at the right stage.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Pyrethrum farmers, researchers, processors, Extension staff and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organized farmer groups or common interest groups (CIGs) Availability of Extension services County and National governments’ support Funding
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> Organized farmer groups or Common Interest Groups (CIGs) to promote appropriate flower picking practice. Availability of extension services to train and create awareness about flower picking County and National Governments to fund and promote the practice. County Governments to provide necessary farm implements at subsidized prices. Pyrethrum processors to mobilize contracted farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up Scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	Weak research-extension-farmer linkage in TIMP delivery
Suggestions for addressing the	<ul style="list-style-type: none"> Enhance Public Private Partnerships (PPP) to support

challenges	<p>increased adoption</p> <ul style="list-style-type: none"> • Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of beneficial parts of the technology.
Lessons learnt in up scaling if any	There is high pyrethrin yield loss due to the practice of farmers picking flowers at the wrong stages of development.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • The practice is socially acceptable as it brings household incomes • The practice has as no negative impacts to the environment • Market policies should be put in place to set minimum buying price for flowers and to regulate processors. • Market will absorb the increased productivity • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	4 man days x 1 acre x 18 picking cycles X527/= 39,944/=
Estimated returns	150,000 – 39944 = 110,056/=
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Flower picking is mainly left to women hence men may not adopt the practice. • Women and youth have limited access to credit to purchase the required inputs . • Women and youth have limited access to land for cultivation . • Women have less access to agricultural information, technology and knowledge .
Gender related opportunities	<ul style="list-style-type: none"> • Opportunity exists for women to access the required credit through the women enterprise funds. • There is the opportunity for Improved livelihoods opportunities for both genders
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have higher illiteracy, poverty, market access problems • VGM have less access to information technology and Knowledge. • VGM have limited access to resources • VGM have limited access to training and extension services • VGM have low adoption rates due to lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • VMGs can get engaged in flower picking as it is not labour intensive • Opportunity exists for VGM to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • The practice has been adopted by many farmers as part of the Good Agricultural Practices
Application guidelines for users	<ol style="list-style-type: none"> 1. KARI Information Brochure series / 63/ 2009; Pick pyrethrum at the correct stage 2. KALRO Pyrethrum Propagation manual 2019

	3. AFA Pyrethrum Growers Manual 3 rd Edition 2019
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3- requires further research)	Ready for up scaling
G. Contacts	
Contacts	1) The Centre Director KALRO Molo P.O Box 100, 20106 - Molo 2) Pyrethrum Processing Company of Kenya P.O Box 420, Nakuru
Lead organization and scientists	Kenya Agriculture Livestock and Research Organization Irene Muriithi, Janet Obanyi, Carolyne Imbwaga, Edward Pertet Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSME

2.5.8 Cutting back (Management practice)

2.5.8 TIMP Name	Cutting back
Category (i.e. technology, innovation or management practice)	Management Practice  <p><i>Sickle used to cut back pyrethrum.</i></p>
A: Description of the technology, innovation or management practice	
Problem to be addressed	Reduced yield due to accumulation of dry flower stalks at the end of a growing season
What is it? (TIMP description)	<p>Cutting back is the practice of cutting dry flower stalks to allow for further growth of new shoots at the onset of rains. It is done once a year to encourage fresh growth, reduce incidence of bud disease and improve production in the next season.</p> <p>The sickle rather than a panga is the tool of choice because it prevents damage of the plant. All the stalks are trimmed only leaving the leaves intact. A slanting motion while cutting is advised to allow for drainage of water.</p> <p>Cutting back should be done at the end of the dry season followed by weeding and earthing up of the plants immediately after cutting back. These dry stalks should be removed from the fields and burned to ease in weeding and reduce the risk of harboring pests and diseases.</p>

Justification	The regeneration after cutting back typically takes about three months, making the crop productive for the rest nine months in a year. This leads to an increase in number of flowers per plant, hence translating to higher yields and an increase in the economic return of production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum farmers, researchers, processors, extension staff and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organized farmer groups or common interest groups (CIGs) Availability of extension services County and National government support Funding for dissemination of the TIMP Sensitization on the practice Field demonstration plots
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> Organized farmer groups or Common Interest Groups (CIGs) to promote appropriate the practice Availability of extension services to train and create awareness County and National governments to fund and promote the practice. County governments to avail necessary farm implements at subsidized prices. Pyrethrum processors to mobilize farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up Scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> Disorganized farmer groups to ease dissemination of information. Limited information by farmers and agricultural extension service providers (public and private) on the importance of cutting back.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Constitute innovation platform to facilitate interaction of farmers with relevant stakeholders for information sharing through field days, workshops and trainings. Enhance capacity of farmers through awareness and sensitization

	<p>campaigns and workshops on merits of cutting back practice.</p> <ul style="list-style-type: none"> • Capacity build public and private agricultural extension service providers with information • Form CIGs to ease dissemination of information
Lessons learnt in up scaling if any	Farmers adopting cut back of flowers record higher yields in the subsequent seasons
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • The practice is socially acceptable as it brings household increased incomes • Market policies should be put in place to set minimum buying price for flowers and to regulate processors • Market will absorb the increased productivity • Supporting frameworks/policies are available • Enabling policies by county and National governments.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	5md x 1 acre x 527 = KES 1285
Estimated returns	210,000/= To be achieved from the second year after planting
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The practice is labour intensive hence left to men, this would limit the adoption of the practice by women. • Women have less access to agricultural information, technology and knowledge on the technology . • Women have limited access to education, training and extension services • Women have less access to land - so they have to rely on their husbands to select and apportion land for pyrethrum cultivation • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on the practice . • VMGs may also have limited access to finances • VMGs have limited access to education, training and extension services . • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Farmers adopting cut back of flowers record higher yields in the subsequent seasons.
Application guidelines for users	<ol style="list-style-type: none"> 1. KALRO Pyrethrum Propagation Manual 2019 2. AFA Pyrethrum Growers Manual 3rd Edition 2019
F: Status of TIMP readiness (1-ready for up scaling; 2-	Ready for up scaling

requires validation; 3-requires further research)	
G. Contacts	
Contacts	1) The Centre Director KALRO Molo P.O Box 100-20106, Molo 2) Pyrethrum Processing Company of Kenya P.O Box 420, Nakuru
Lead organization and scientists	KALRO Irene Muriithi, Janet Obanyi, Carolyne Imbwaga, Edward Pertet, Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSME

Gaps: Need for development of a mechanized cut back equipment


2.5.9 Crop Rotation (Management Practice)

2.5.9 TIMP Name	Crop Rotation
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low flower yields due to mono-cropping
What is it? (TIMP description)	This is a practice of growing different types of crops (or none at all) in the same area over a sequence of seasons. Pyrethrum is a perennial crop that has a growth period of 3-4 years. It is uneconomical to maintain the crop in the field after the 4 years. After the 4 th year clonal plants should be uprooted and re-planted in clean fields where pyrethrum had not been planted between 3-6 years before. For varietal plant material, the crop should be uprooted and discarded. Clean seeds for propagation should be obtained from PPCK for crop re-establishment. For rotation purposes, a cereal crop such as maize, wheat, barley or oats should be planted after pyrethrum. Other methods of rejuvenating include leaving the field to fallow. Such crops reduce nematode population in the soil because they are poor hosts.
Justification	Pyrethrum crop should not be left in the field on the same spot for more than 4 consecutive years since it has reduced vigor and has reduced yields due to age, soil exhaustion, disease and pest effect. The aim of crop rotation is to replenish soil fertility, breakdown life cycles of weeds, diseases and pests.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum Farmers, researchers, extension staff, processors and agripreneurs.
Approaches to be used in	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS)

dissemination	<ul style="list-style-type: none"> • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Access to affordable soil testing services • Good seed system to ensure quality and availability • Well organized farmer groups and networks • Good Marketing Models and path ways • County and National government support • Collaboration between all partners and stakeholders
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> • Organized farmer groups or Common Interest Groups (CIGs) to promote the practice • Availability of extension services to train and create awareness • County and National Governments to fund and promote. • County governments, National governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate extension officers for effective training farmers on appropriate methods of land preparation • Willingness of farmers to adopt the practice. • Weak Research-extension-farmer linkage
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Enhance Public Private Partnerships (PPP) to support increased adoption • Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of beneficial parts of the management practice.
Lessons learnt in up scaling if any	<ul style="list-style-type: none"> • There is need for farmers to use good quality planting materials that maintain high yields for four years of the crop season. • Most farmers disregard this recommendation hence training and practice dissemination should be enhanced.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • There are no social issues that would hinder development and up scaling on this Practice. • Policy's that govern pyrethrum production are in place.

	<ul style="list-style-type: none"> There are no Environmental concerns of the practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established
Estimated returns	To be established
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women have less access to land - so they have to rely on men to select and allocate how land will be used. Women have less access to agricultural information, technology and knowledge . Women and youth have less access to credit to purchase the required inputs. Women have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> Affirmative action fund opportunities such as the women and youth enterprise fund exist for them to access the required finances Youth have opportunities in land preparation and use of farm implements
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to land to practice crop rotation. VMGs have limited access to training and extension services. Due to their social status VMGs are often excluded from Decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> Opportunity exists for women to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> Affirmative action opportunities exist for women and youth to access the required credit.
Application guidelines for users	<ol style="list-style-type: none"> KALRO Pyrethrum Propagation manual 2019 AFA Pyrethrum grower's manual 2019
F: Status of TIMP readiness (1- ready for up scaling; 2- requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	<p>1) The Centre Director KALRO Molo P.O. Box 100-20106, Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O. Box 420, Nakuru</p>
Lead organization and scientists	<p>KALRO</p> <p>Irene Muriithi, Janet Obanyi, Carolyne Imbwaga, Edward Pertet, Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua</p>
Partner organizations	PPCK, County Governments, AFA, KEPHIS, MSME

2.5.10 Intercropping (Management practice)


2.5.10 TIMP Name	Intercropping
Category (i.e. technology, innovation or management practice)	Management Practice  <p><i>Pyrethrum intercrop.</i></p>
A: Description of the technology, innovation or management practice	
Problem to be addressed	Decrease in arable land size per household due to increasing population density
What is it? (TIMP description)	Intercropping is the growing of two crops that complement each other on the same piece of land with the aim of maximizing the land's output per season. In the case of pyrethrum, an additional non-climbing leguminous crop is planted in proximity during the growing season. The aim is to produce higher yields on one piece of land by using of resources that would otherwise not be utilized by a single crop. (greengrams, groundnuts, cowpeas and bean) Leguminous crops which fix nitrogen are usually preferred as the second crop. Legume intercropping not only increases the productivity of pyrethrum but also reduces weed incidence and lowers field maintenance cost. In addition, higher plant stands results when pyrethrum is intercropped with soybean and dolichos tend to lower nematode infestation.
Justification	Pyrethrum stays in the field for three to four years. When the crop is young or cut back around March, the field remains with no economic yield for three consecutive months after which flowering starts. Thus, the introduction of cover crops in the production system during the earlier growth stages will help maintain its production and increase on land productivity. In the past, pyrethrum was grown predominantly in pure stands but currently due to competition over land, the crop is indiscriminately being intercropped with other crops. There is need for the further validation of this practice to establish the economic benefit of different intercrop variations as well as the effects of the intercropping on pyrethrum yield and crop establishment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Pyrethrum Farmers, researchers, Extension staff, processors and agripreneurs.
Approaches to be used in	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS)

dissemination	<ul style="list-style-type: none"> • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of good seed of preferred leguminous crop • Demos farms on various mixes of pyrethrum and legumes • Availability of markets and good prices for the legumes • Organized farmer groups or Common Interest Groups (CIGs) to take up promotion on intercropping options. • Availability of extension services to train and create awareness about intercropping
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> • Agricultural Extension for farmer sensitization, On-farm and-on station demonstrations and training • NGOs and CBOs for organizing farmers into uptake groups and funding them • Private Extension providers: capacity build farmer groups • County governments: funding and promotion • National government: policy and allocation of funds
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Bomet, Kisii, West Pokot, Elgeyo Marakwet, Nyandarua
Counties where TIMP will be up scaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate extension officers for effective training farmers on appropriate methods of land preparation • Willingness of farmers to adopt the practice. • Weak Research-extension-farmer linkage
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Enhance Public Private Partnerships (PPP) to support increased adoption • Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of beneficial parts of the management practice.
Lessons learnt in up scaling if any	
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • There are no social issues that would hinder development and up scaling on this practice. • Policy's that govern pyrethrum production are in place. • There are no environmental concerns of the practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be established

Estimated returns	To be established
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women have less access to land - so they have to rely on men to select and allocate how land will be used. • Women have less access to agricultural information, technology and knowledge. • Women and youth have less access to credit to purchase the required inputs. • Women have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action fund opportunities such as the women and youth enterprise fund exist for them to access the required finances • Youth have opportunities in land preparation and use of farm implements
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land to practice intercropping. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from • Decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunity exists for women to access the required credit through the women enterprise funds.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youth to access the required credit.
Application guidelines for users	<ol style="list-style-type: none"> 1. KALRO Pyrethrum Propagation manual 2019 2. AFA Pyrethrum grower's manual 2019
F: Status of TIMP readiness (1-ready for up scaling;, 2- requires validation; 3-requires further research)	Requires validation
G. Contacts	
Contacts	<p>1) The Centre Director KALRO Molo P.O. Box 100 - 20106 Molo</p> <p>2) Pyrethrum Processing Company of Kenya P.O Box 420, Nakuru</p>
Lead organization and scientists	KALRO Irene Muriithi, Janet Obanyi, Carolyne Imbwaga, Edward Pertet, Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	PPCK, County governments, AFA, KEPHIS, MSME

Gaps: The practice needs more research on more intercrop options and their effects to production

2.5.11 Pyrethrum Clones/Variety selection (Management practice)

2.5.11 TIMPs name	Pyrethrum Clones/Variety selection
	 <p><i>High status pyrethrum crop in PPCK farm photo (Source: Carolyn Imbwaga)</i></p>
Category	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low flower yields and Low pyrethrin content due to planting of pyrethrum clones/varieties in inappropriate environments
What is it? (TIM P description)	This is the identification of a variety/clone suitable for planting in an intended area, so as to maximise on the yields and quality.
Justification	<p>The different pyrethrum clones/varieties do not perform uniformly across all pyrethrum growing zones. The practice of not matching the variety with the appropriate environment has led to low yields.</p> <p>To optimize on pyrethrum yields and quality, it is necessary to grow the clone that is best suited to the locality/area /zone. This will ensure high yields and pyrethrin quality across all regions of pyrethrum production.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, seed merchants, commercial nursery operators, processors, dealers, researchers, and agripreneurs.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media

	short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Quality planting material available (seed and vegetative) • accessibility and affordability • Strong linkage among pyrethrum growers' value chain actors • Strong partnership linkages • Awareness campaigns
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Public and private extension service providers- To help in the technology dissemination • NGOs: –Partner in technology dissemination through on-farm demonstrations • Seed companies –Agri-business and marketing of the technology • Processors –provision of market for the dry flowers, processing and value-added products • Educational institutions- Providing the information • County governments –Assist in the dissemination of the technology, Linking farmers to processors
C: Current situation and future scaling up	
Counties where already promoted, if any	West Pokot
Counties where TIMP will be upscaled	Bomet, Nyandarua, Kakamega, Nakuru and the other counties in Kenya where pyrethrum is produced
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate quality planting materials • Resistance to adoption of the new management practices • Unavailability of seed • Competing enterprises
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish sustainable seed systems • Avail breeder seed for seed multiplication • Provision of adequate finances for the project
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization and on-farm trials are practical ways of enhancing adopting technologies. • Partnership and awareness creation are important in technology dissemination and adoption
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • The value chain is socially acceptable • Conducive environment for pyrethrum crop production • Ability of market to absorb increased productivity • Supportive frameworks and policies are available • Increase in demand for use of safe products in addressing food safety concerns, and climate change awareness.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	1 kg of seed costs Kshs. 4500 1 pc tissue culture plantlet Kshs. 70 1pc seedling Kshs.3
Estimated returns	Kshs.170,000 per acre per year. (to be verified)

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women have limited access to production resources such as land, knowledge, information, extension training, and credit and quality seed. • Women have limited access to education, training and extension services . • Children are mainly engaged as part of family labour in picking
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to production resources such as land, knowledge, information, extension training, and credit and quality seed. • VMGs have limited access to education, training and extension services . • Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit
E: Case studies/profiles of success stories	
Success stories from previous similar projects	1. Research has demonstrated that varieties perform best in their most suitable environments
Application guidelines for users	1. Pyrethrum Growers manual
F: Status of TIMP readiness (1-ready for up scaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director KALRO - Molo P.O Box 100 - 20106 Molo 2) Pyrethrum Processing Company of Kenya P.O Box 420 Nakuru
Lead organization and scientists	KALRO Irene Muriithi, Janet Obanyi, Carolyne Imbwaga, Edward Pertet, Robert Lagat, Lewis King'ori, Lusike Wasilwa, Violet Kirigua
Partner organizations	Pyrethrum Processing Company of Kenya Carolyne Imbwaga County governments AFA

Gaps:

Breeding of new varieties and development of technologies for use in enhancing pyrethrum production

References

1. Pyrethrum Growers Manual 2nd Edition WGM Ottaro - 1998
2. Pyrethrum Growers Manual 3rd Edition Agriculture and Food Authority - 2019
3. Pyrethrum Seed Rules KEPHIS – 2015

2.6 SOIL FERTILITY MANAGEMENT AND WATER CONSERVATION

2.6.1 Fertilizer Use and Recommendation (Innovation)

2.6.1 TIMP Name	Fertilizer Use and Recommendation
Category (i.e. technology innovation, or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Inherent low nutrient supply by soils, mining of nutrient by crop extraction, acid soil infertility, soil salinity and nutrient toxicities caused by natural and man-made causes.
What is it? (TIMP description)	Fertilizer use and recommendation is a research based set of guidelines and management practices for supplying fertilizer to crops to achieve agronomic yields in a manner that reduces nutrient losses to the environment
Justification	Fertilizers are industrially produced by enriching specific plant nutrients in forms that are readily available for plant uptake to improve on crop growth and yields. The recommendation and use is guided by a soil test report specifying identified nutrient deficiencies, adequacies and toxicities. They are usually fast acting, environmentally safe and cost effective for increased crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, stockists of fertilizers, County governments, National Government, researchers, scientists, NGOs, and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of fertilizers in the market at subsidized prices • Soil test reports for site specific fertilizer recommendation

	<ul style="list-style-type: none"> • Advocacy, promotion on the benefits of fertilizer use by County governments, National government and PPCK • Soil sampling and testing campaigns in pyrethrum growing regions to guide on types and quantities of fertilizer required • Development of factsheets on fertilizer use in pyrethrum
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO - Research and extension training, development of extension materials • County governments - Promotion and awareness campaigns on benefits of using fertilizers • Pyrethrum Processing Company of Kenya - Policy development guidelines on fertilizer access, prices, suppliers • National government - Provide subsidies and tax breaks on fertilizers
C: Current situation and future scaling up	
Counties where already promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • High market prices for fertilizers • Lack of right information about site specific fertilizer • Supply of compound fertilizer predominantly
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • National government to upscale availability of subsidized fertilizers • Increase awareness and importance of soil sampling and testing • Government, industry and distributors to provide blended fertilizers and manufacturers to make more blends that include micro-nutrients
Lessons learned in scaling up	<ul style="list-style-type: none"> • Distribution of subsidized fertilizer is skewed • Lack of subsidized fertilizer at the onset of the planting season • There is a big demand for fertilizer uptake
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Fertilizer market, supply and distribution in Kenya is organised comprising of local and international players. • The national government has rolled out a fertilizer subsidy program that advocates for social inclusion of smallholder farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The price of a 50 kg bag of fertilizer under the government subsidized fertilizer program costs KES 2500.00
Estimated returns	<ul style="list-style-type: none"> • Use of site specific fertilizer recommendation assures over 70% of current yields
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Fertilizer use and recommendation is a management practice that can be easily adopted by men, women and the youth
Gender related opportunities	Fertilizer application on the farms is a high labour intensity and would provide both men and women seasonal jobs
VMG issues and concerns in development	Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current fertilizer use due to distribution

dissemination, adoption and scaling up	challenges
VMG related opportunities	This is a TIMP that will provide information on the importance and benefits of fertilizer use for improved pyrethrum production
E: Case studies/profiles of success stories	
Success stories	The National Agricultural Accelerated Input Access Project (NAAIAP) (MoALD, GoK) successfully implemented a fertilizer access programme to the subcounty level based on Laboratory analysis data for the maize value chain in 2014
Application guidelines for users	<ol style="list-style-type: none"> 1. Have soils sampled and tested for fertility evaluation 2. Involve county extension staff in implementing the fertilizer use and recommendation 3. Implement the recommendation fully to achieve target yield
F: Status of TIMP readiness (1=Ready for up-scaling; 2=Requires validation; 3=Requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>
Lead organization and Scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.,
Partner organizations	County governments, PPCK, Fertilizer Manufactures, International Research Organizations

2.6.2 Diagnosis of Plant Nutrient Deficiency and Toxicity (Innovation)

2.6.2 TIMP name	Diagnosis of Plant Nutrient Deficiency and Toxicity
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Crop nutrient deficiencies in soils contribute to reduced crop yields and plant quality hence compromise food productivity and nutritional quality.
What is it? (TIMP description)	Diagnosis of plant nutrient deficiency and toxicity is a process of identifying whether nutrients in a soil are available in sufficient amounts that support normal plant growth. The toxicities and deficiencies are identified visually

	through qualitative assessment based on symptoms such as stunted growth and/or yellowing of leaves occurring as a result of nutrient stress. Nutrient deficiency occurs when an essential nutrient is not available in sufficient quantity to meet the requirements of a growing plant. Toxicity occurs when a nutrient is in excess of what a plant needs and decreases plant growth or quality.
Justification	Plants require essential nutrients for normal functioning and growth. A plant's sufficiency range is the amount of nutrients necessary to meet its nutritional needs and maximize growth. Nutrient levels outside of a plant's sufficiency range cause overall crop growth and health to decline due to either a deficiency or toxicity. It is important to conduct a diagnosis of plant nutrient deficiency and toxicity to inform the future nutrient management of the plants
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension staff, and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training farmers on basic principles of visual diagnosis of plant nutrient deficiency symptoms, similarities, occurrence of multiple deficiencies/toxicities and false deficiency symptoms • Availability of information materials • Availability of knowledgeable trainers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO- Produce training materials, carry out training and back-stopping for ToTs and Lead farmer • PPCK- Mobilization of pyrethrum growing farmers, formulate policy for pyrethrum promotion • County Governments- Prioritize pyrethrum farming by enabling extension staff to work closely with farmers
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up- scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Organizing training sessions • Lack of immediate remedial action for macro nutrient

	<p>deficiencies/toxicities</p> <ul style="list-style-type: none"> • It is a subjective qualitative assessment dependent on individual eyesight • Confuses between plant diseases and plant nutrient deficiency
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Plan for training sessions when the physical crop is growing to compliment pictures • Incorporate plant tissue and soil testing to ascertain deficiency/toxicity • Train farmers on the distinct difference between nutrient deficiency symptoms and crop diseases
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Availability of well-developed farmer groups can promote training. • Conducting well publicized campaigns has been found to add to the success of plant nutrient deficiency/toxicity visual diagnosis.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Train more farmers on plant nutrient deficiency/toxicity in all pyrethrum growing Counties • Create awareness on the importance of diagnosing and remedying plant nutrient deficiency/toxicities
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Time to attend the training is required which cannot be quantified with regards to cost
Estimated returns	<ul style="list-style-type: none"> • Reduce crop losses due to manageable plant nutrition challenges
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • This management practice easily be adopted by men, women and youth in implementing, adoption and scaling up
Gender related opportunities	<ul style="list-style-type: none"> • Women and Youth can be trained as nutrient deficiency/toxicity scouts to serve farmer group and generate income
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Visual diagnosis will discriminate people with visibility impairment
VMG related opportunities	<ul style="list-style-type: none"> • Can be trained to work as community workers offering nutrient deficient/toxicity diagnosis services and report to the extension officers
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • Plantwise Programme supported by CABI, KALRO and MoALD. This initiative has trained 750 plant doctors and established 350 plant clinic across Kenya. The plant doctors were trained on diagnosing plant disease symptoms and give corrective action advisories to farmers in their localities.
Application guidelines for users	<ol style="list-style-type: none"> 1. Plant Nutrient Deficiency Terminology 2. Burning: severe localized yellowing; scorched appearance 3. Chlorosis: general yellowing of the plant tissue; lack of chlorophyll 4. Generalized: symptoms not limited to one area of a plant, but rather spread over the entire plant

	<p>5. Interveinal Chlorosis: yellowing in between leaf veins, yet veins remain green</p> <p>6. Localized: symptoms limited to one leaf or one section of the leaf or plant</p> <p>7. Mottling: spotted, irregular, inconsistent pattern</p> <p>8. Necrosis: death of plant tissue; tissue browns and dies.</p> <p>9. Stunting: decreased growth; shorter height of the affected plants</p>
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.,
Partner organizations	County Governments, KEPHIS, Public Private Partnerships, International Research Organizations, PPCK

2.6.3 Determination of Crop Nutrient Requirements (Innovation)

2.6.3 TIMP name	Determination of Crop Nutrient Requirements
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Poor crop productivity due to lack of knowledge for farmers on specific plant nutritional requirements
What is it? (TIMP description)	Identifying crop nutrient requirements is a research-based methodology that uses field trial experimental data that matches crop nutrient requirements for target high yield with soil fertility test results.
Justification	<p>Understanding that different crop species require specific nutrients in varying amounts at different physiological stages helps in guiding the timing of applying organic and inorganic nutrients to support plant growth and achieve the desired yields.</p> <p>It assists in managing nutrient losses and achieving agronomic nutrient use efficiency of applied nutrients by controlling toxicity.</p>
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, extension staff, NGOs, researchers, and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Sources of plant nutrients • Functions of individual plant nutrients • The quantity of plant nutrients required • Factors influencing availability of applied plant nutrients in the soil
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO- Conduct research to establish specific crop nutrient requirements for maximum yields, provide training materials, conduct training to farmers and extension staff, backstopping lead farmer training by ToTs • PPCK- Formulate policy on accreditation of fertilizer suppliers to the pyrethrum sub sector • Pyrethrum farmers- To implement advisory on pyrethrum nutrient management • County governments- To provide extension support to pyrethrum farming • National government- To upscale distribution and utilization of the fertilizer subsidy program among pyrethrum farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of small holder finance and credit supply to buy fertilizers • Lack of linkages between research and smallholder farmers • Low awareness among farmers • Low trust from farmers after the collapse of the pyrethrum industry
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Contract farming that will link farmers and credit institutions • Policy formulation to fund research linked to small holder farmers • Awareness campaigns by county, national government to promote understanding on matching crop nutrient requirements and soil fertility • Conduct massive campaign to resurrect interest in pyrethrum

	farming through incentives such as provision of farm inputs at subsidized rates
Lessons learnt if any	<ul style="list-style-type: none"> • Reviving and funding pyrethrum farmers cooperatives • Linking farmer cooperatives with Pyrethrum Processing Company of Kenya (PPCK) regulated industry processors and formulators
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Train more farmers on importance of matching pyrethrum crop nutrient requirements and soil nutrient content in all pyrethrum growing Counties • PPCK to generate market demand for natural pyrethrin for its safe use and environmental friendliness to encourage interest for more uptake of pyrethrum growing
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Conduct sampling and testing at the cost of Kshs. 1000.00 per soil sample to get an advisory from KALRO Kabete to match pyrethrum nutrient requirements and the soil test analysis report
Estimated returns	<ul style="list-style-type: none"> • Attain over 70% of the current yields
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Adoption of the crop nutrient requirement accords men, women and youth equal opportunity for increased pyrethrum productivity
Gender related opportunities	<ul style="list-style-type: none"> • Men will procure right amount of fertilizer based on crop nutrient requirement, women and youth will spend the right amount of time to apply the fertilizer and save time for other community and economic engagements
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women, young mothers, youth will provide labour during application of soil amendments to match crop requirements
VMG related opportunities	<ul style="list-style-type: none"> • Earn income as casual labourers applying the nutrients in form of manure, lime and fertilizer application to replenish soil nutrients
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	1. Follow strictly the advisories as prescribed
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI.</p>

	E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County governments, PPCK, Public Private Partnerships, MoALD

2.6.4 Conservation Agriculture (CA) (Management practice)

2.6.4 TIMP name	Conservation Agriculture (CA)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed:	Rapid depletion of soil organic matter due to conventional tillage that regularly disturbs the soil leading to low water holding capacity, nutrient losses through volatilization, erosion and leaching
What is it? (TIMP description)	Conservation Agriculture is a farming system that promotes minimum soil disturbance (i.e. no tillage), maintenance of a permanent soil cover, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency, and improved and sustained crop production
Justification	<p>Agricultural production under the conventional practice is fast becoming an intensive nutrient extraction system that is accelerating nutrient depletion, soil degradation, and reduced yields coupled with high cost of replenishing plant nutrients. To reverse this trend, conservation agriculture provides a sustainable approach that aims to produce high crop yields while reducing production costs, maintaining the soil fertility and conserving water.</p> <p>Conservation agriculture aims at achieving sustainable agriculture and improve livelihoods.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, CBOs, researchers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer to farmer extension models Mass media – Electronic and print Publications -posters/brochures/leaflets, manuals Digital Platforms– Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Promotion through training on the principles and benefits of conservation agriculture Establish model demonstration plots in pyrethrum growing counties
Partners/stakeholders for scaling up, their roles and stage of involvement	<ul style="list-style-type: none"> County governments, International Research Institutions, CBOs
C: Current situation and future scaling up	
Counties where already promoted if any	-Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega g
Challenges in dissemination	<ul style="list-style-type: none"> Rigidity in farmers' mindset on shifting from conventional farming to conservation agriculture Competing uses for crop residues among households such as animal feed, domestic consumption versus retaining it in the farms Inaccessibility to herbicides and specialized equipment for implementing conservation agriculture
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Continuous training and implementation of field crop production in partnership with the farmers under Conservation Agriculture practice Providing legume seeds for ground cover on conservation agriculture farms and alternate farms to provide crop residue for fodder Provide initial herbicides and engage service providers in stocking the herbicides. Engage and train local artisans on fabricating the equipment for conservation agriculture
Lessons learnt in up scaling if any	<ul style="list-style-type: none"> Mind sets of local farmers negative about conservation agriculture for soil fertility improvement. Inadequate skills in the technology and its management practices Small holder farmers tend to adopt one or two of the tree principles
Social, environmental, policy and market conditions necessary for development and dissemination	<ul style="list-style-type: none"> Reliable technology adoption and suitable price and market access for produce grown under conservation agriculture practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> Focuses on reducing production costs
Estimated returns	<ul style="list-style-type: none"> Returns dependent on the technology and value chain
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> Conservation agriculture for sustainable soil fertility improvement is a complementary technology that can be easily adopted by men, women and the youth

Gender related opportunities	<ul style="list-style-type: none"> • Conservation Agriculture eliminates pre-tilling of land hence reduces workload for men, women and youth • Herbicide use reduces household resources used in hiring casual labour
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Use of planters, seeders and herbicides reduces demand for rural single, widows, unemployed youths planting and weeding services denying them income
VMG related opportunities	<ul style="list-style-type: none"> • Increased all year food availability, yields and food varieties provides for value addition opportunities and selling directly to the markets
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Has been extensively used in the cereal legume cropping systems with remarkable success in Kenya implemented by African Conservation Tillage Network (ACT)
Application guidelines for users	<ol style="list-style-type: none"> 1. Disturb the soil as little as possible 2. Keep the soil covered as much as possible. 3. Mix and rotate crops
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera F.M., Obanyi J.N., Lagat R.K., Muriithi I.W.
Partner organizations	County government, Cooperatives, International Research Organizations, PPCK

2.6.5 Soil Sampling and Testing (Innovation)

2.6.5 TIMP name	Soil Sampling and Testing
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Declining soil plant nutrient provision capacity, increased soil acidity, reduced soil organic matter content, low and declining yields, low use of organic and inorganic inputs and diagnosis of plant nutrient deficiencies


What is it? (TIMP description)	Soil sampling is the collection of soils from the field for the purpose of delivering it to a soil testing laboratory for fertility evaluation with respect to plant nutrition.
Justification	In the pursuit of sustainable agricultural production, ensuring high yields per unit of land is necessary while also conserving the soil resources. A soil test is the first step in identifying soil-related constraints with the goal of achieving higher yields while practicing the best soil fertility management practices geared towards maximising agricultural productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, NGOs and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training farmers on soil sampling • Establish communication channel such as toll free numbers that farmers call on soil sampling and testing issues • Adequate qualified staff to cover the large number of samples from the target counties before the planting season begins. • A well-designed storage system for keeping information obtained at farm level including (GPS locations, physical description of the locations, raw data, and fertilizer recommendation according to crop type suitability). Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services; providing the link to farmers given that agriculture is devolved. • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers • National government to regulate availability of fertilizer through subsidy or pricing
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma

Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • Lack of information among small holder farmers of existence of soil testing services • The cost of setting up a soil testing laboratory is high, hence fewer laboratories • The soil testing laboratories are close to high food producing regions • The cost of soil analysis is deemed high for small holder farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation, intensive farmer field training on carrying out soil sampling (capacity building) • Reduced taxes on analytical instruments imported into the country • Set up at least one soil testing laboratory in each of the 47 counties • Convince the farmers that the cost charged by KALRO is subsidized and cheapest in the country
Lessons learnt, if any	<ul style="list-style-type: none"> • Farmers appreciate the importance of soil sampling and testing when they receive the information for the first time. • Most farmers lacked expertise on how to collect soil samples.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Increased productivity will provide supply to the markets supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1000.00 per soil sample
Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 50% of current returns and no doubt will be make pyrethrum growing great again.
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • By bringing services closer to the users saves time and resources to the farmers (men, women and youth).
Gender related opportunities	<ul style="list-style-type: none"> • Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling. • Retooling of personnel at national and county levels.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current soil testing services due to distances and costs
VMG related opportunities	<ul style="list-style-type: none"> • This is a TIMP that will bring soil testing services nearer to this group of farmers and therefore is a saving and also is expected to improve pyrethrum production
E: Case studies/profiles of success stories	
Success stories, if any	<ul style="list-style-type: none"> • Kalro Kabete Laboratory Analytical Services analyses up to 15,000 soil samples annually though it has the capacity to do 25,000 soil

	samples. This high analytical capacity of the laboratory can be fully utilized by pyrethrum farmers in Kenya
Application guidelines for users	<ol style="list-style-type: none"> 1. Tools for soil sampling are trowel, spade, shovel, spoon, knife auger, sample storage bags, 20-litre bucket 2. Community soil sampling champions are identified and trained on good soil sampling procedures. 3. Soil is analyzed and the results including fertilizer recommendations generated within 10 working days 4. Mode of results dispatch is either email or physical collection 5. Soil Test Report is valid for 3 years
F: Status of TIMP readiness 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director, KALRO Kabete, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.,
Partner organizations	County governments, CropNuts, International Research Organizations, Cooperatives, PPCK

2.6.6 Integrated Manure Management (IMM) (Management Practice)

2.6.6 TIMP name	Integrated Manure Management (IMM)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	<ul style="list-style-type: none"> • Land degradation, characterized by declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health • Poor manure management and handling, which lead to increased Green House Gases (GHG) emissions
What is it? (TIMP description)	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops.

	
Justification	<p>Declining soil fertility in smallholder system is a major factor inhibiting agricultural development. It is estimated that soils are depleted at annual rate of 22 kg/ha for nitrogen, 2.5 kg/ha for phosphorous, and 15 kg/ha for potassium.</p> <p>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.</p> <p>Adding manure to soils enhances soil fertility and soil health, leading to increased agricultural productivity.</p> <p>Manure is the best option for smallholder systems to provide the limiting nutrients and improve soil health</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training on feeding, management and use of manure • Effective dissemination approach to reach target farmers • Model demonstration plots using cereal crops
Partners/stakeholders for scaling up and their roles	<p>County governments to provide extension services, farmer mobilization and policy formulation</p> <p>KALRO- technical backstopping</p> <p>NGOs – micro financing services</p>

C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of model demonstration farms • Cultural challenges: Low interest by pastoral communities • Lack of continuity in training of extension service and farmers in manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establishment of many demonstration plots by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of interested farmers and extension workers • Use of approaches that mobilize farmer to attend demonstration forums
Lessons learnt if any	<ul style="list-style-type: none"> • Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Manure should be well prepared, stored and applied.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Applying manure to soils saves on purchase of expensive inorganic fertilizer, increases crop yields, returns and saves water. • Likelihood of propagation of invasive species to crop fields is high if manure is not fully composited • Poorly composited manure can harbour pathogens which can cause disease outbreaks to livestock • Contamination of water sources by leaching of nutrients • Organic manures when poorly handled increase GHG emissions. However, IMM provides practices that are able to minimize GHG emissions.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Proper handling of manure, high labour requirement due to its bulkiness, building a compost heap, maintaining it and finally transporting and applying it field take a lot of effort and time</p> <p>Using locally available manure/composts saves on purchase of inorganic fertilizer.</p>
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	It is labour intensive in terms of handling and application (often by broadcasting) hence may disadvantage women
Gender related opportunities	Manure is locally available from farm households who keep livestock, hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of handling and application hence may disadvantage VMGs. The VMGs are also resource poor and may not have access to adequate manures, e.g. need many livestock
VMG related opportunities	Manure is locally available for those farm households with livestock and can build on what they already own
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt integrated manure management practice have reported improved soil health and increased crop yield, and sustainable source of income
Application guidelines for users	The guideline focuses on the following areas: <ol style="list-style-type: none"> 1. Animal feeds 2. Livestock housing and manure collection 3. Manure storage to preserve nutrient and avoid losses 4. Manure treatment for ease of transport and application in the field 5. Timing of application for maximum utilization by the crop 6. Anaerobic digestion for biogas production 7. Regular analysis of manure to ascertain the quality 8. Manure/Composts take a long time to cure, hence need good planning prior to use
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County government, Private Public Partnerships,

	International Research Organizations, Cooperatives, PPCK
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Gaps:

1. Promote IMM complementary technology in counties that have not practiced it.
2. Conduct nutrient budget study on selected farms utilizing manures (including composts) in pyrethrum growing counties.

2.6.7 Integrated Soil Fertility Management (ISFM) (Management Practice)

2.6.7 TIMP name	Integrated Soil Fertility Management (ISFM)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Declining soil fertility, low organic matter, restoring soil structure and conserving the limited available moisture in crop production.
What is it? (TIMP description)	It is a set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed that are used in combination in adapting to local conditions. It places emphasis on the importance of using inorganic fertilizer and organic inputs efficiently through fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence).
Justification	Soils within the farming systems are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. A large proportion of soils in the NAVCDP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents


	<ul style="list-style-type: none"> • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of affordable and quality manure, fertilizers and clean planting materials • Assessing variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income • Amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services: to provide link with farmers. • Community farmer groups: to play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, is required since farmers tend to re-use previous planted materials.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a technically demanding technology and high cost in areas where application of ISFM is non-responsive
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development, dissemination, adoption and scaling up	<p>The practice integrates participation of male and female gender roles during field activities. Female gender is disadvantaged where application of heavy loads of manure are to be incorporated in the field.</p> <p>Adoption and scaling up of ISFM technologies could be affected by the ownership of the farm that are mainly male owned where the man does</p>

	not own the technology
Gender related opportunities	Apart from the inorganic fertilizers and good seed, the practice adopts other locally available materials that saves on cost which is good for all gender in the farm household.
VMG issues and concerns in development, dissemination adoption and scaling up	VMGs are physically disadvantaged for a practice that seeks to incorporate manures in the farm. They are also resource poor and may not have the resources to purchase seed and fertilizers as required for successful implementation of the practice.
VMG related opportunities	The technology if well practised can increase farm incomes of VMGs by up to 50%.
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in sorghum and millet value chains in Machakos where productivity have been greatly improved
Application guidelines for users	<ol style="list-style-type: none"> 1. Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients. 2. Ensure that good agronomic practices are upheld 3. For sustainability, lone use of inorganic or organic materials should be avoided.
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.,
Partner organizations	County governments, International Research Organizations, Cooperatives, PPCK

Gaps:

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

2.6.8 Low-Cost Composting (Innovation)

2.6.8 TIMP Name	Low-Cost Composting
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	<p>Organic wastes constitutes the highest percentage of waste flow in Kenya leading to big landfills especially near the urban centres.</p> <p>However, there is low awareness on appropriate low cost composting technologies and lack of supporting policies. Moreover, lack of proper composting management and handling leads to increased GHG (Green House Gases) emissions.</p>
What is it? (TIMP description)	<p>Composting is the biological decomposition of organic material by bacteria, fungi, worms and other organisms under controlled aerobic conditions resulting in an accumulation of partially decayed organic matter called humus. Composting is an effective process for recycling organic wastes for use in agriculture.</p>  <p><i>Composting using plant residues</i></p>
Justification	<p>Compost contains the nutrients nitrogen, phosphorus and potassium which are normally found in most chemical fertilizers. Additionally, it provides secondary and trace elements such as zinc, iron and magnesium, which are not typically present in chemical fertilizers but are useful in growing plants.</p> <p>Compost adds balanced nutrients to soil in an easily assimilated form, and helps improve soil structure by lightening heavy clays and enhancing water retention properties in porous sands</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on station Agricultural shows/exhibitions/field days

	<ul style="list-style-type: none"> • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training on different composting techniques and use • Dissemination approach used to reach target farmers • Model demonstration plots using cereal crops
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services - Provide link with farmers. • Community farmer groups - play coordination role for ease in problem identification and dissemination • KALRO and International Livestock Research Institute - technical backstopping • NGOs – micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of model demonstration farms • Lack of continuity in training of extension and farmers in composting skills • Lack of proper mobilization mechanism to reach many farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establishment of many demonstration plots by counties • Capacity building of smallholder farmers on composting management • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	<ul style="list-style-type: none"> • Proper use of composts to improve soil fertility • Use of composts to enhance crop productivity • Skills in composting methodologies and minimizing health risks associated with composts making
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Composting requires care when handling wastes that would normally contain heavy loads of pathogens. • In addition, compost pits if not well managed can be sources of contamination through leaching.

	<ul style="list-style-type: none"> Using composited manures on soils saves on purchasing of inorganic fertilizer, increases crop yields, returns and saves water. Hence socially and environmentally acceptable
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> Preparation of composts require labour for building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time Using locally available composts saves on purchase of inorganic fertilizer.
Estimated returns	Returns dependent on crop and crop varieties in the value chain where composting is practised
Gender issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of preparation and application (often by broadcasting) hence may disadvantage women
Gender related opportunities	Composts sources are available in farms and households hence opportunities available for both men and women.
VMG issues and concerns in development, dissemination, adoption and scaling up	It is labour intensive in terms of preparation and application hence may disadvantage VMGs.
VMG related opportunities	Materials for compost making include household wastes and only require one to be trained on composting techniques to ensure compost quality.
E: Case studies/profiles of success stories	
Success stories	Farmers who use composts in quickly maturing crops have reported 3 to 5 times increased production due to improved soil health and better income
Application guidelines for users	Karanja NK, Kwach HO, Njenga M (2005). Low-cost composting training manual. Techniques based on the UN Habitat urban harvest CIP community-based waste management initiative.
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>

Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County government, International Research Organizations, Cooperatives, PPCK

Gaps:

1. Promote composting technology in counties that have not practiced it.
2. Conduct nutrient budget study on selected farms using composts in the pyrethrum growing Counties.

2.6.9 Rapid Soil Testing Services (Innovation)

2.6.9 TIMP name	Rapid soil testing services
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	<ul style="list-style-type: none"> • Conventional methods for soil testing are not affordable for farmers, take a long time to yield results and are not reproducible. • The methods do not provide solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. • Current methods do not provide a framework for large-scale assessment of geo-referenced sampled points using standardized protocols. • Limited access to soil testing services due to centralized soil testing laboratories and high costs.
What is it? (TIMP description)	Rapid soil testing services is a dry method for soil testing using simplicity of light - the interaction of electromagnetic radiation with matter to characterize biochemical composition of soil and plant tissue. Partners involved (KALRO, ICRAF and AgroCares) work closely with and county agricultural officers to sensitize farmers to embrace the testing method.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents

	<ul style="list-style-type: none"> • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion.	<ul style="list-style-type: none"> • Availability of the necessary equipment for rapid on the spot soil testing. • Established rapport between farmers and the technical personnel involved in soil testing. • Adequate qualified staff to cover the large number of samples from the pyrethrum growing counties before the planting season begins. • A well-designed storage system for keeping information obtained at farm level including GPS readings, physical descriptions of the locations, raw measured scanned data, and fertilizer recommendations according to crop type suitability. Additionally, having a van available to mount the equipment is essential. • Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services: providing the link to farmers given that agriculture is devolved. • Soil Cares: provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF: tests and validates the recommendation obtained in collaboration with AgroCares and KALRO. • Fertilizer companies: To provide fertilizer blends according to soil health status • Agro dealers: to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	
Counties where already promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • It requires continuous updating methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated pipelines for updating existing recommendation

	methods.
Lessons learnt in upscaling if any	<ul style="list-style-type: none"> • Timely affordable soil information will guide on fertilizer use. • Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Sulphur.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Soil testing equipment and consumables, sampling and packaging materials, personnel. The actual costs will be determined upon consultation. • Shipping selected soil and plant materials for further testing and results verification in a certified lab.
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	By bringing services closer to the users saves time and resources to the farmers (men, women and youth).
Gender related opportunities	<ul style="list-style-type: none"> • Offers employment especially for the youth where soil sampling champions will be trained to help the local community in sampling. • Retooling of personnel at national and county levels.
VMG issues and concerns in development, dissemination adoption and scaling up	Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted current soil testing services due to distances and costs
VMG related opportunities	This is a TIMP that will bring soil testing services nearer to this group of farmers and therefore is a saving and is also expected to improve productivity.
E: Case studies/profiles of success stories	
Success stories	Has been tested and used successfully by other organizations like ICRAF and AgroCares It has been adopted at Kenya Cane Testing Centre for checking maturity level and quality of sugarcane.
Application guidelines for users	<ol style="list-style-type: none"> 1. A handheld scanner to testing soils and crops in the field 2. Community soil sampling champions are identified and trained on good soil sampling procedures. 3. Soil and crop is analyzed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness	Requires validation

(1=Ready for upscaling; 2=Requires validation;3= Requires further research)	
G: Contacts	
Contacts	1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org 2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County governments, AgroCares, ICRAF, PPCK


Gaps:

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

2.7 SOIL AND WATER MANAGEMENT

2.7.1 Fanya Juu Terraces (Management practice)

2.7.1 TIMP name	Fanya Juu Terraces
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
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 Kiswahili 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 pyrethrum may then be grown in between two embankments. Through gradual


	<p>redistribution of soils within the field, the terraces level off. The technology is highly suitable in low annual rainfall areas (less than 700 mm); moderate slopes (less than 20%); deep soils (more than 60 cm); and hilly areas that are subject to widespread erosion.</p>  <p><i>Fanya Juu terrace</i></p>
Justification	<p>The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods. Agricultural production is threatened in many parts of Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces leads to better and more reliable crop yields.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct contour bunds. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on-farm demonstration plots to hold farmer field schools. • KALRO – capacity building, training material development and access to technology

C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • Increased risk of soil erosion if terraces are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Farmers need to be advised on the appropriate equipment for preparation of terraces for efficiency and increased output per man hour. • Training youthful farmers to be champions of 'Fanya juu' terraces construction at the Ward level/village level. • Training on-site specific designs and construction of 'Fanya juu' terraces • Fast-track land registration
Lessons learnt, if any	<ul style="list-style-type: none"> • 'Fanya juu' terracing is popular due largely to the rapid benefits that accrues from it in terms of soil and water conservation. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them have been found willing to invest in the management practice.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at county level • Create awareness on the importance of soil and water conservation • Provide localized training to those lagging behind in adoption of soil and water conservation management practices. • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for terrace construction. The cost 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"> • Ownership of or access to land may limit women in implementing the technology • Limited decision-making power on land use may limit

	<p>women in accessing and adopting the technology</p> <ul style="list-style-type: none"> • Differing accessibility of the technology and information may disadvantage women and in some instances men • Limited access to credit will affect adoption and scaling up among women.
Gender related opportunities	<ul style="list-style-type: none"> • Increased agricultural production will increase access to food and income among all gender. • Youthful male and women will provide labour during the implementation of the technology.
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Limited access to information will limit access to information and adoption • Limited decision making power on land use may limit VMG in accessing and adopting the technology • May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The technology is labour intense and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	<ul style="list-style-type: none"> • Application of contour ridge is expected to improve agriculture production thus, more food and income for the VMGs.
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in lower Eastern counties of Kenya have recorded 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	<ol style="list-style-type: none"> 1. 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. 2. Stone terrace walls can be built to reinforce the bunds on very steep slopes to allow surplus water to pass between the stones without damaging the terrace. Excess water can be drained from the trenches using cut-off drains.
F: Status of TIMP readiness 1=(Ready for upscaling, 2= Requires validation3= Requires further research)	Ready for upscaling
G: Contacts	

Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County Governments, Public Private Partnerships, Cooperatives, PPCK, International Research Organizations

2.7.2 Contour bunds(Management practice)

2.7.2 TIMP name	Contour bunds
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased run off, along with; low water retention capacity in most soils
What is it? (TIMP description)	<p>Contour bunds are stone or earthen walls built across a slope to prevent runoff. Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund, formed by excavating a channel, creates a small ridge on the downhill side. The resulting contour bunds are narrow channel terraces commonly referred to as “<i>Fanya chini</i>” terraces. The management practice is highly suitable for areas with unpredictable rains.</p>  <p style="text-align: center;"><i>Contour Bunds</i></p>
Justification	The current manifestations of climate change seen as low and erratic rainfall, threaten agricultural production, food security and livelihoods. Contour bunds and hedgerows concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. They also decrease the risk of erosion. Plants with higher water

	requirements, such as pyrethrum, may be planted on the higher side of the furrow whereas cereal crops requiring less water can be planted on the ridges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Most effective approach	Model farm demonstration
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct contour bunds. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • Increased risk of soil erosion if contours are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals do not have land title deeds
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Farmers need to be advised on appropriate equipment for preparation of contour for efficiency and increased output per man hour. • Training youthful farmers to be champions of contour bunds construction at the Ward level/village level.


	<ul style="list-style-type: none"> • Training on site specific designs and construction of contour bunds • Fast-track land registration
Lessons learnt, if any	<ul style="list-style-type: none"> • Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Provide localized training to those lagging behind in adoption of soil and water conservation management practices. • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for contour preparation. The cost 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"> • Ownership of or access to land may limit women in some regions • Making decisions on land use may limit women in some region where decision making is men dominated • Differing accessibility of the technology and information may disadvantage different gender • The technology is labour intensive hence may disadvantage women and members who cannot procure labour services • Differing accessibility of information between men and women because of gender norms that place access to new information and technologies in the hands of male heads will affect adoption and scaling up. • Ownership of or access to land and credit will affect adoption and scaling up.
Gender related opportunities	<ul style="list-style-type: none"> • Increased agricultural production will increase access to food and income among all gender. • Potential for employment creation - youthful male and women will provide labour during the implementation of the technology.
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> • Limited of access to information may limit the VMG from technology access and use

adoption and scaling up	<ul style="list-style-type: none"> Limited attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges limits use of technologies. The technology is labour intensive and may be difficult for the VMG to implement in the field. The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs Competing priorities and household decisions might hinder adoption and scaling up.
VMG related opportunities	<ul style="list-style-type: none"> Application of contour ridge is expected to improve agriculture production thus, more food and income for the VMGs.
E: Case studies/profiles of success stories	
Success stories, if any	
Application guidelines for users	<ol style="list-style-type: none"> Soil is excavated up-slope of the bund to a depth of 50 cm. Contour bunds should drain in one direction and can be manually or machine constructed. The length of a bund across a slope should be between 400 to 500 m. The height of a bund should be at least 25 cm and have an approximate spacing of 1-2 m. In arid areas, the distance between bunds can be increased to 5-10 m. Hedgerows grown to stabilize bunds should be spaced at 4 to 8 m across the slope.
F: Status of TIMP readiness (1=Ready for upscaling, 2=Requires validation; 3=Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.,
Partner organizations	County Government's extension offices, Public Private Partnerships, International Research Organizations, Cooperatives, PPCK

Gaps:

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

2.7.3 Retention ditches (Management practice)

2.7.3 TIMP name	Retention ditches
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased run off
What is it? (TIMP description)	<p>Retention ditches are trenches designed to trap and retain incoming runoff holding it until it infiltrates into the ground. They may be an alternative to waterways in high rainfall areas, but they are most often used in semi-arid areas to harvest water. The technology is suitable in semi-arid areas; permeable, deep and stable soils; and on flat or gentle sloping land.</p>  <p><i>Retention ditches</i></p>
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print


	<ul style="list-style-type: none"> • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct stone lines. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • Increased risk of soil erosion if retention ditches are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals do not have land title deeds
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Farmers need advice on appropriate tools for digging out retention ditches for efficiency and increased output per man hour. • Training youthful farmers to be champions of digging out retention ditches. • Training on site specific designs and layout • Fast-track land registration
Lessons learnt, if any	When the farmers are adequately trained and sensitized on the management practice, uptake increases.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Provide localized training to those lagging behind in adoption of soil and water conservation management practices. Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for digging retention ditches. 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"> • Limited ownership of or access to land may limit women from technology implementation • Limited power in making decisions on land use may limit women in technology adoption • The technology is labour intensive and may limit implementation by women • Differing accessibility to information between men and women because of gender norms that place access to new information and technologies in the hands of male heads of will affect adoption and scaling up. • Limited access to appropriate tools and credit may limit application of technology among specific gender e.g. women
Gender related opportunities	<ul style="list-style-type: none"> • Increased agricultural production will increase access to food and income among all gender. • Youthful male and women will provide labour during the implementation of the technology.
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Limited access to information will limit access to information and adoption • Limited decision making power on land use may limit VMG in accessing and adopting the technology • May not be in attendance during awareness and sensitization campaigns due to physical body challenges or insecurity challenges. • The technology is labour intense and may be difficult for the VMG to implement in the field. • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs
VMG related opportunities	<ul style="list-style-type: none"> • Application of contour ridge is expected to improve agriculture production thus, more food and income for the VMGs.
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in Eastern and Central Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involved digging of retention trenches in hillside to trap runaway water and soil.
Application guidelines for users	<ol style="list-style-type: none"> 1. 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. 2. 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.
F: Status of TIMP readiness 1-Ready for upscaling, 2-Requires validation; 3- Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County Government's extension service, Public Private Partnerships, International Research Organizations, Cooperatives, PPKC

2.7.4. Bench terraces (Management practice)

2.7.4. TIMP name	Bench terraces
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The risk of soil erosion and increased runoff; and low water retention capacity in most soils
What is it? (TIMP description)	<p>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.</p>


	 <p><i>Bench terraces</i></p>
Justification	Agricultural production is threatened in many parts of 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.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension staff and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of labour as the technology is labour intensive. • Farmers and extension service with skills to design and construct contour bunds. • Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension service providers – delivery of information to farmers, technology access, capacity building • Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. • External service providers – capacity building and access to technology
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega

Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • Increased risk of soil erosion if terraces are improperly laid out • Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals do not have land title deeds
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Farmers need to be supported with appropriate equipment for preparation of bench terrace for efficiency and increased output per man hour. • Training youthful farmers to be champions of making bench terraces construction at the ward level/village level. • Training on site specific designs and construction of bench terraces • Fast track land registration
Lessons learnt, if any	<ul style="list-style-type: none"> • Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Enforce policies on soil and water conservation at the county level • Create awareness on the importance of soil and water conservation • Provide localized training to those lagging behind in adoption of soil and water conservation management practices. • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for bench terrace preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope
Estimated returns	The returns depend on the value chain being addressed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Making decisions on land use may limit specific gender • Differing accessibility between men and women because of gender norms places access to new information and technologies in the hands of male heads of will affect adoption and scaling up. • Ownership of or access to land and credit will affect adoption and scaling up.
Gender related opportunities	<ul style="list-style-type: none"> • Increased agricultural production will increase access to food and income among all gender. • Both men and women will provide labour during the implementation of the technology.

VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • The technology demands proper training and access to information to enable proper implementation. This might be lacking among the VMGs • Lack of access to information will limit the VMG accessing and adopting the technology • Competing priorities and household decisions might hinder adoption and scaling up.
VMG related opportunities	<ul style="list-style-type: none"> • Application of bench terraces is expected to improve agriculture production thus, more food and income for the VMGs.
E: Case studies/profiles of success stories	
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	<ol style="list-style-type: none"> 1. 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. 2. Terraces should drain runoff along the horizontal gradient of the slope, either in outward or reverse direction. The outward gradient can range from 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%.
F: Status of TIMP readiness (1=Ready for upscaling, 2=Requires validation; 3=Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O. Box 100-20106 Molo</p>

	Email: kalro.molo@kalro.org 2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County Government, Public Private Partnerships, International Research Organizations, Cooperatives, PPCK

2.7.5 Mulching (Management practice)

2.7.5 TIMP name	Mulching
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	<ul style="list-style-type: none"> Accelerated loss of soil moisture leading to water stress in the soil. Suppression of weeds, loss of organic matter, managing salinity.
What is it? (TIMP description)	<p>The practice of covering the soil/ground with natural materials such as straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production.</p> <p>Benefits: retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose).</p>  <p><i>Mulched pyrethrum plot</i></p>
Justification	Mulching 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 minimizes weed problems

	and nutrient loss. It also improves soil structure directly by preventing raindrop impact and indirectly by promoting biological activity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of plant or crop residues. • Size of the land. • Competing uses of crop residues. • Type of the crops • Willing farmers to adopt effective management practices being promoted
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>
C: Current situation and future scaling up	
Counties where already promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	Counties with suitable agro-ecological settings for pyrethrum production.
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of enough plant and crop residues due to competing uses • Possibilities of insect build up categorized as pest or disease vectors
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Crop diversification to increase availability of residues. • Establish and follow a good integrated pest control management program for the particular crop. • Adopting alternative mulching materials like high absorbance polymers normally used in fruit trees like mangoes and bananas.
Lessons learnt	There is need to adapt to alternative mulching

	technologies in addition to use of organic materials like crop, plant residues, and agricultural processing wastes.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is low cost but labour intensive during the initial application. Such costs are dependent on value chain and plant spacing.
Estimated returns	Dependent on value chain but generally >100% of the initial investments.
Gender issues and concerns in development, dissemination, adoption and scaling up	The practice uses remnants from previous crops/plants that may offer competition in terms of fuelwood and livestock thus bringing a conflict those performing the specific tasks, e.g. women in case of fuelwood and men for livestock feed. This will negatively affect the adoption and scaling up.
Gender related opportunities	Women who mainly perform the weeding tasks will get a relief and spend their efforts elsewhere. Similarly, the improved productivity will benefit both gender in terms of higher earnings.
VMG issues and concerns in development, dissemination, adoption and scaling up	Though easy to use, it is be a bit labour intensive for VMGs, hence its adoption and scaling up
VMG related opportunities	Mulch is locally available on-farm, and thus has very low costs implying that all including VMGs can take advantage of the practice.
E: Case studies/profiles of success stories	
Success stories	Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	<ol style="list-style-type: none"> 1. Mulch management 2. Pull or kill weeds that grow out of the mulch. Mulch is meant to act as a barrier for weeds and grass. You should pull any weeds or grass that grow out of the mulch bed throughout the year to prevent future growth. 3. Rake the mulch occasionally to prevent it from getting packed down. Compacted mulch prevents oxygen from passing through and can starve your crop's roots. 4. Replenish the mulch once a year. Make it a point to replenish the mulch around the tree once a year. This

	will prevent weeds, provide essential nutrients, and help with the soil drainage.
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation;3= Requires further research	Requires further research
G: Contacts	
Contacts	<p>1) The Centre Director , KALRO Molo P.O Box 100-20106 Molo Email: kalro.molo@kalro.org</p> <p>2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County governments, Public-Private-Partnerships, International Research Organizations, Cooperatives, PPCK

Gaps:

Research on mulching using factory/industrial wastes, e.g. mushroom, tea, coffee, etc. in different value chains is required.

2.8 IRRIGATION AND DRAINAGE

2.8.1 Water Testing for Irrigation Suitability (Innovation)


2.8.1 TIMP name	Water testing for Irrigation Suitability
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Guard against increased soil salinity and nutrient toxicity which interferes with water infiltration, lowers crop productivity and destroys soil structure.
What is it? (TIMP description)	Water testing for irrigation suitability is the collection of water intended for irrigation and delivering it to a laboratory for analysis. The laboratory tests for dissolved salts that could harm crops and degrade the soil structure.
Justification	In seeking alternative moisture provision to crop production, due diligence should guide against use of unsafe irrigation water with high salinity and nutrient toxicities, which may reduce yield and further deteriorate soil fertility. Irrigation water suitability test is the

	first step in identifying water-related constraints.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training farmers on water sampling and testing • Establish effective communication channels such as toll free numbers that farmers call on water sampling and testing issues • Adequate qualified staff to cover the large number of samples from the target counties • A well-designed storage system for keeping information obtained at farm level including (GPS readings, physical description of the locations, raw data, and water recommendation according to crop type suitability). • Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services; providing the link to farmers given that agriculture is devolved. • Business people dealing in irrigation distribution systems • Water Regulatory Authority to test water and regulate use in accordance with relevant law • KALRO to provide advisory and also test the water
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> • Lack of information on water sampling and testing for irrigation suitability among the farmers • Few irrigation water testing laboratories in the counties • High cost of equipment and reagents used in irrigation water analysis
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Creating awareness among the farmers on importance of irrigation water testing

	<ul style="list-style-type: none"> Establish irrigation water suitability testing laboratory in pyrethrum growing counties Zero rate taxation on equipment and reagents used in irrigation water quality testing
Lessons learnt, if any	<ul style="list-style-type: none"> Farmers expressed enthusiasm in irrigation water testing after learning of case studies on symptoms of induced soil salinity when using non tested irrigation water
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> Socially acceptable-brings income, increases food production, nutrition security and family cohesion. Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. Increased productivity will provide supply to the markets Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 600 per water sample
Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 50% of current returns and no doubt will be make pyrethrum growing great again.
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> By bringing services closer to the users saves time and resources to the farmers (men, women and youth).
Gender related opportunities	<ul style="list-style-type: none"> Offers employment especially for the youth when farming becomes intensive because of improved moisture availability Youth employment as water sampling champions
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Willingness to adopt and scaling up technology by VMGs given that farmers have not adopted irrigation water testing services due to lack of information
VMG related opportunities	<ul style="list-style-type: none"> This is a TIMP that will bring irrigation water testing services nearer to this group of farmers and therefore generate savings and improve pyrethrum production
E: Case studies/profiles of success stories	
Success stories, if any	
Application guidelines for users	<ol style="list-style-type: none"> 1. Water sampling done for ground and surface water sources 2. Collect water samples using mineral water bottle of 500 ml 3. Water analysis report given classifying the water and giving advisory on suitability for irrigation
F: Status of TIMP readiness 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org

	2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County governments, Cooperatives, International Research Organizations, PPCK

2.8.2 Drip irrigation systems for small scale farmers (Innovation)

2.8.2 TIMP name	Drip irrigation systems for small scale farmers
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Increased crop water stress caused by seasonal rainfall variability in rain fed production.
What is it? (TIMP description)	<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 is easy to design and operate.</p> <p>The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water</p>  <p><i>Layout of a drip irrigation system in pyrethrum for nurseries</i></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: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Model Farmers and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Correct field design (system installation) of the drip system to minimize water inefficiencies. Training of farmers and extension • Drip management skills
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County governments; capacity building, supportive policies and frameworks • Private sector (AMIRAN); facilitate access to technology; technology demonstration; access to credit • NGOs (Kenya Red Cross- KRC, Action Aid, World Vision, and OXFAM); facilitate access to technology; technology demonstration
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be promoted	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Relatively high cost of drip kits for majority of poor resource farmers • High temperatures experienced cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes is required (use of PVC pipes) to manage clogging free flow of water • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of

	drip irrigation system
Lessons learnt	<ul style="list-style-type: none"> • Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system have also helped preserve moisture and additional nutrients to the soil • It is also important to link farmers to Micro Finance Institutions for financial needs
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Capacity building for increased awareness creation • Policy support for increased investments in drip irrigation systems • The water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Inputs materials include water source, drip lines, drippers, and 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"> • Income from drip system rises by as much as 35% stemming from the management of crop water stresses. • Increased water saving means more water are available for other competing needs (domestic, livestock or industrial).
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Drip systems are easily installed and therefore suitable for both male and female gender • Drip system tend to reduce workload for all gender and provides significant positive impact on family food and nutritional intake. • Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems. This may increase their labor hours • Acceptable and easy to scale up by both male and female, including youth
Gender related opportunities	Opportunities available for women and men to generate sustainable income
VMG issues and concerns in development, dissemination, adoption and scaling up	The technology fits well with the VMGs and easily installed and manageable, thus improving nutrition for the VMGs
VMG related opportunities	Drip technology reduces the workload to the VMGs and provides an opportunity to make business because they are mostly done on high value crops such as pyrethrum
E: Case studies/profiles of success stories	
Success stories	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.

Application guidelines for users	References 1. Isaya V. Sijali, 2001. Drip Irrigation: Options for smallholder farmers in eastern and southern Africa. Technical Handbook No. 24. Published by SIDA's Regional Land Management Unit, Nairobi. 2. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/3/a-i3765e.pdf
F: Status of TIMP readiness (1. Ready for Up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	1) The Centre Director , KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org 2) The Centre Director KALRO Kabete, P.O. Box 14733-00800, NAIROBI. E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirliff, and many Micro finance institutions (MFIs), PPCK

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.

2.9 AGROFORESTRY SYSTEMS

2.9.1 Agroforestry for soil fertility (Management practice)

2.9.1 TIMP Name	Agroforestry for soil fertility
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and loss of biodiversity


What is it? (TIMP description)	<p>Agroforestry for soil fertility is a management practice that combines the use of several farm techniques to enhance land productivity through improving soil fertility, increasing crop yields, boosting soil water retention and reducing soil erosion. It makes use of improved fallows, hedgerows, mixed cropping and multi-strata systems. It works through:</p> <ul style="list-style-type: none"> • Improved fallows; Leguminous trees planted in natural fallows • Hedgerow intercropping /alley cropping; Leguminous tree species planted in hedges • Green manure; Biomass from growing leguminous plants that are cut at a certain height and ploughed back to the soil as source of manure • Mixed cropping; system of sowing two or three crops (that includes a legume) together on the same land, where one is the main crop and others are considered subsidiaries. • Multi-strata; an agroforestry system whose components (crops, trees, shrubs, livestock) occupy distinct layers of the vertical structure of the community.
Justification	<p>Agroforestry for soil fertility is a promising approach that integrates organic and inorganic fertilizers in most rural farms in Kenya. The free organic fertilizer is sourced from the improved fallows of leguminous trees, shrubs, herbaceous legumes and biomass transfer. Agroforestry with leguminous trees increases the productivity, improves soil structure and protects the soil against erosion and nutrient losses by maintaining a permanent soil cover and minimizing soil disturbance. It also conserves soil water and enhances biodiversity.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training on principles and benefits of agroforestry legumes for green manure • Model demonstration plots using cereal crops
Partners/stakeholders for scaling up and their roles	County governments: extension services; Community mobilization and support: Supporting frameworks/policies at the local level

	KALRO and KEFRI: Implementing institutions
C: Current situation and future scaling up	
Counties where already promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Current extent of reach	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Counties where the TIMP will be up-scaled	Counties with suitable ecological requirements for pyrethrum production
Challenges in dissemination	<ul style="list-style-type: none"> • Limited species appropriate to different agro-ecological zones • Shortage of seed • Many farmers lack knowledge and skills needed to grow them • Change of mindset • Competing interests • Land tenure (farmers reluctant to invest in agroforestry technologies where they do not have clear land rights)
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Enhance Public Private Partnerships to support increased production and market access • Improve county government capacity to train and re-tool technical team so as to enhance uptake of the technology • Provide inputs and credit • Allocation of more funds for continued research and dissemination of this technology would aid increased uptake agroforestry for soil fertility
Lessons learnt	<ul style="list-style-type: none"> • Mind sets of local farmers negative about agroforestry for soil fertility improvement. • Inadequate skills in the technology and its management practices
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Trees may be socially acceptable as they may provide fuel wood in future (particularly to the women and youth who form the labour force in pyrethrum production) in the target communities. • The youth may welcome the management practice since they are likely to benefit from increase labour to tend to the increased crops in the shamba • Tree will benefit the environment when planted by many communities • The market will be willing and able to absorb the extra produce arising from the increased production.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Dependent on the technology being promoted, though minimal focusing on labour costs
Estimated returns	Returns dependent on the technology and value chain
Gender issues and concerns in development and dissemination	Agroforestry for soil fertility with trees is a complementary technology that can be easily adopted by men, women and the youth

Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> • Agroforestry provides opportunities for SMEs e.g. tree nurseries. The technology therefore renders itself to easy adoption by both men and women. • Providing ready markets of the produce can also be an issue upon scaling up.
Gender related opportunities	There are opportunities for the rural women and unemployed youths in seed and seedlings sales e.g. tree nurseries
VMG issues and concerns in development and dissemination	The VMGs can easily get access to the products of the practice, e.g. source of fuelwood
VMG issues and concerns in adoption and scaling up	Taking care of the introduced agroforestry systems in their farms require labour.
VMG related opportunities	SMEs such as tree nurseries for increased resilience and income generation
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt the technology have reported increased and sustainable source of income
Application guidelines for users	1. Adopters of agroforestry for soil fertility will need training to decide appropriate tree species to plant
F: Status of TIMP readiness (1=Ready for up-scaling; 2=Requires validation; 3=Requires further research)	Requires validation
G: Contacts	
Contacts	1) The Centre Director , KALRO Molo P.O. Box 100-20106 MOLO Email: kalro.molo@kalro.org 2) Centre Director KALRO Kabete, P.O. Box 14733-00800, Nairobi. E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO - Wandera, F.M., Obanyi, J.N., Lagat, R.K., Muriithi, I.W.
Partner organizations	County government, Private Public Partnerships, International Research Organizations, Cooperatives, PPCK

2.10 PYRETHRUM CROP HEALTH

2.10.1 Integrated Pest Management of Green Peach Aphids (Management practice)

2.10.1. TIMP name	Integrated Pest Management of Green Peach Aphids (<i>Myzus persicae</i>)
	 <p><i>Green peach aphids on leaves of pyrethrum leaves (Janet Obanyi, 2022)</i></p>
Category (i.e. technology, innovation or management practice)	Management practices
A: Description of the technology, innovation or management practice	
Problem addressed	Aphids cause 30% yield loss in pyrethrum production.
What is it? (TIMP description)	<p>A management practice which deploys several control methods - cultural, biological and chemical control approaches to control the aphids as follows:</p> <p>Cultural Practices</p> <ul style="list-style-type: none"> • use of yellow traps to monitor aphid population • removal of weeds from the farm • removal and destruction of infested plants • spraying soapy solution (15 tablespoon liquid soap in 20lt of water) to infested crop. <p>Biological control</p> <ul style="list-style-type: none"> • Spraying the crop with Azadirachtin (Achook, Fortune, Neemraj Super, Nembecidine, Ozoneem) or Aphitech (<i>Aphidius transcaspinus</i>, a parasitic wasp), Biocatch (<i>Verticillium lecanii</i>), Bio-Power (<i>Beauveria bassiana</i>), Botanigard (<i>Beauveria bassiana</i> strain GHA) at recommended rates by the manufacturers. <p>Chemical control</p> <ul style="list-style-type: none"> • Spraying with Deltamethrin (Atom, Decis) or Lambda-cyhalothrin (Karate, Duduthrin).
Justification	<p>Currently there indiscriminate overuse of synthetic insecticides to control aphids, leading to traces of pesticide residues in the crop thus affecting the quality of pyrethrins.</p> <p>The use of Integrated Pest Management methods in the management of aphids will offer farmers several management options such as cultural measures and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option and their use</p>

	should be minimized. Adoption of an IPM approach would minimize overuse of synthetic pesticides, enhance food safety and increase productivity and incomes for farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products, Agrochemical dealers, Formulators, Traders, Agripreneurs, Processors, NGOs, Cooperative Societies, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied Research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension/companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations for marketing pyrethrum and to provide seed and information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and apply in production • County governments, national government (e.g. Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to use pyrethrum (e.g. Real IPM, Farm Africa) for farmer organization and mobilization

	<ul style="list-style-type: none"> Seed companies for quality seed multiplication Financial institutions (e.g. Banks, donors and other credit facilitators) for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. Availing the biopesticides in agro-input outlets closer to the farmers and at affordable prices Low use of good agricultural practices (GAP) by farmers due to low skills and lack of knowledge in this space
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Establish pyrethrum innovation platforms Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. Availing resources for dissemination Making sticky traps, biopesticides and biologicals available and accessible Research to develop/validate more IPM technologies Information dissemination on production practices Promotion of IPM practices in the suitable areas Promote marketing models that encourage collective production and marketing Develop good policy for the use of IPM in management of pest Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> Chances of successful scaling are high when diverse value chain stakeholders collaborate in an innovation platform Farmers are receptive to the IPM technology once sensitized and demonstrated Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Environmental safety considerations since it minimizes pesticides in produce Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms

	<ul style="list-style-type: none"> • The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them • It is already “a climate change ready management practice” due to its wide adaptation ability • There should be an IPM policy and policy review from time to time.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for insecticides and application per acre per season, KES 4000 per acre for sticky traps and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 29,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 30% of KES 210,000-300,000 (i.e. a loss of 63,000-90,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in spraying which is mostly done by youth and men • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPM inputs • Slow information and awareness flow to female farmers due to low academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Limited youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Empower women and youth to acquire land and IPM inputs such as biopesticides • Reach more women groups with the pyrethrum IPM information




	<ul style="list-style-type: none"> • Well-organized gender friendly markets and marketing system • Make gender friendly IPM training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources and information • Financial constraints • Integrated management of the pest and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPM trading conditions • Empower the VMGs by linking them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ul style="list-style-type: none"> • Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyn Imbwanga. Pyrethrum Processing Company of Kenya Limited. • Kenya Pyrethrum Compendium. 2022. Janet Obanyi. • Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; <i>In</i> Plant Diseases, American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. • Causal agent of pyrethrum wilt and factors influencing the disease development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. • Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo

	Email: kalro.molo@kalro.org 2) The Centre Director, KALRO-Kabete P.O. Box 14733-00800.Nairobi Email: cd.narl@kalro.org <u>KALRO Call Center: 0111010100</u>
Lead organization and scientists	KALRO Otupa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD, Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs, Formulators, Processors

Gaps:

- Explore bio-control options for management of aphids
- Explore the efficacy of bio-pesticides and ITKs in pest management at different stages of the aphid pest
- Validation of tolerance of new varieties to aphids

2.10.2 Integrated Pest Management of Flower Thrips [*Thrips nigropilosus*] and Onion thrips [*Thrips tabaci*] (Management practice)

2.10.2. TIMP name		Integrated Pest Management of Flower Thrips (<i>Thrips nigropilosus</i>) and Onion thrips (<i>Thrips tabaci</i>)		
				
	<i>Thrips</i> (Source: Infonet biovision)	Onion thrip (<i>Pyrethrum compedium</i>)	Thrip infestation on <i>pyrethrum</i> (Janet, 2023)	
Category (i.e. technology, innovation or management practice)	Management practice			
A: Description of the technology, innovation or management practice				
Problem addressed	Pyrethrin quality and flower yield losses of 30 to 60% due to crop damage by the thrips			
What is it? (TIMP description)	<p>Integrated pest management (IPM) of thrips is the combination of cultural, biological, biopesticides and synthetic insecticides control methods as follows:</p> <p>Cultural practices</p> <ul style="list-style-type: none">• Scouting the fields twice weekly, looking for thrips,• Removal restruction of infected crop residues• Practising crop rotation for a period of at least 6-8 weeks and ensure that the young crop is not planted next to an older infected crop or an alternative host crop			

	<ul style="list-style-type: none"> • Removal of weeds that can serve as alternative hosts and harbour the pest season after season • Intercrop with garlic/spider plant/coriander and use yellow sticky traps (8 traps/acre) to trap thrips. <p>Biological control Spraying with Azadirachtin (Neemark, Nemros, Achook), Nimbecidine or Beauvitech (<i>Beauveria bassiana</i>) or Biopower (<i>Beauveria bassiana</i>), or Botanigard (Azadirachtin)</p> <p>Chemical control</p> <ul style="list-style-type: none"> • Alpha-cypermethrin (e.g. Alfatox, Tata Alpha) • Acetamiprid (e.g. Aceta, Acetak Top).
Justification	<p>Currently most farmers are using a lot of synthetic pesticides in the management of this pest leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in the management of this pest will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies and CGIARs producing bio-pesticide/biological products, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.</p>
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied Research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IPM strategies

	<ul style="list-style-type: none"> • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and international research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents (e.g. Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs (e.g. Real IPM, Farm Africa) to take up pyrethrum for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective

	<p>production and marketing</p> <ul style="list-style-type: none"> • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are high when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for insecticides and application per acre per season, KES 4000 per acre for sticky traps and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 29,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 30-60% of KES 210,000 (i.e. a loss of 63,000-126,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum

	<ul style="list-style-type: none"> • Financial empowerment - the poor farmers lack funds to acquire IPM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPM inputs such as biopesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.


Application guidelines for users	<ul style="list-style-type: none"> Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya Limited. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; <i>In</i> Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. Causal agent of pyrethrum wilt and factors influencing the disease development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 – 20106 Molo Email: kalro.molo@kalro.org</p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 - 00800.Nairobi Email: cd.narl@kalro.org</p> <p><u>KALRO Call Center: 0111010100</u></p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD, Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems, County governments, NGOs, Formulators, Processors

Gaps:

- Explore bio-control options for management of aphids
- Explore the efficacy of bio-pesticides and ITKs in pest management at different stages of the aphid pest

Validation of tolerance of new varieties to aphids

2.10.3. Integrated Pest Management of Red Spider mites (*Tetranychus hudei*) (Management practice)

2.10.3. TIMP name		Integrated Pest Management of Red Spider mites (<i>Tetranychus hudei</i>)	
			
		<i>Red spider mite (Pyrethrum compendium, 2022)</i>	
Category (i.e. technology, innovation or management practice)	Management practice		
A: Description of the technology, innovation or management practice			
Problem addressed	Pyrethrin quality and flower yield losses of 30 - 100% due to crop damage by the red spider mite		
What is it? (TIMP description)	<p>A management practice which deploys several control methods - cultural, biological and chemical control approaches - to control the red spider mites as follows:</p> <p>Cultural practices</p> <ul style="list-style-type: none">• Avoid planting new crop next to an infested field• Avoid continuous cropping of pyrethrum and solanaceous plants (potato, eggplant, nightshades) in the same feild• Practising good crop hygiene by removal of infested plants and destroy by burning. <p>Biological Control</p> <ul style="list-style-type: none">• Use of bio-pesticides and soft/safe synthetic chemicals such as Nimbecidine, Achook, Neemroc or apply <i>Phytoseiulus persimilis</i> or <i>Neoseilus californicus</i> (<i>Amblyseius californicus</i>). <p>Chemical Control</p> <ul style="list-style-type: none">• Spray using products based on Abamectin or Abamectin + Acetamiprid or Clofentezine.		
Justification	<p>Currently there is indiscriminate overuse of synthetic insecticides to control aphids, leading to traces of pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in spider mite management will offer farmers several management options such as cultural measures and bio-pesticides that are relatively safe to both human and environment.</p> <p>Soft synthetic pesticides are recommended as a last option and their use should be minimized. Adoption of an IPM approach</p>		

	would minimize overuse of synthetic pesticides, enhance food safety and increase productivity and incomes for farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies and CGIARs producing bio-pesticide/biological products, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel/extension/companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and apply in production • County governments, national government agents (e.g. Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions (e.g. Banks, donors and other credit facilitators) for financial solutions
C: Current situation and future scaling up	

Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyadarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making biopesticides and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are high when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability.

	<ul style="list-style-type: none"> Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for insecticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 30-100% of KES 210,000- (i.e. a loss of 63,000-210,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Labour intensity in planting, weeding, spraying which are mostly done by women and youth Land ownership mainly by men who may have no interest in pyrethrum Financial empowerment - the poor farmers lack funds to acquire IPM inputs Slow information and awareness flow to female farmers due to academic levels Women and youth may not be able to reach far way markets or have bargaining power Lack of youth opportunities in pyrethrum value chain The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. Women and youth friendly production techniques such as mechanization Empower women and youth to acquire land and IPM inputs such as pesticides Reach more women groups with the pyrethrum information Well-organized gender friendly markets and marketing system Apply enterprising mechanized, marketing and value addition channels for the youth Make gender friendly training materials with illustrations to enhance communication to all gender Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management

VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories of resistant varieties such P4, K218 and K235 being grown in pyrethrum growing areas.
Application guidelines for users	<ul style="list-style-type: none"> • Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. • Kenya Pyrethrum Compendium. 2022. Janet Obanyi. • Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. • Causal agent of pyrethrum wilt and factors influencing the disease development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. • Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100-20106 Molo Email: kalro.molo@kalro.org</p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 - 00800.Nairobi Email: cd.narl@kalro.org</p>



	<u>KALRO Call Center: 0111010100</u>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

Explore use of bio-control options for red spider mites

Explore the efficacy of ITKs in the management of pest

2.10.4. Integrated Pest Management of Leaf Miners (*Liriomyza* spp.) (Management practice)

2.10.4. TIMP name				Integrated Pest Management of Leaf Miners (<i>Liriomyza</i> spp.) (Management practice)	
					
		<i>Leaf with leaf miner (A.M. Varela, icipe)</i>	<i>Leaf miner adult (Central Science Laboratory, Harpenden Archive, British Crown, Bugwood.org)</i>		
Category (i.e. technology, innovation or management practice)		Management practice			
A: Description of the technology, innovation or management practice					
Problem addressed		Yield losses of 10 - 30% in pyrethrum quantity and pyrethrin content due to leaf damage by the pest.			
What is it? (TIMP description)		The Integrated management of leaf miner includes a combination of cultural practices, bio-control and chemical control options as follows: Cultural practices <ul style="list-style-type: none">• Avoid planting new crop next to an infested field,• Apply mulch to prevent pupae getting to the soil for further development into adults• Avoid continuous cropping of pyrethrum and solanacea plants (potato, tomato eggplant, nightshades) in the same field• Practise good crop hygiene by removal of infested plants and destroying by burning• Hand pick and destroy mined leaves (in low infestation cases) and those with the larvae still in the tunnel by burying 30cm deep and use yellow sticky trap to attract and kill adult leaf miners.			

	<p>Biological control</p> <ul style="list-style-type: none"> • Use of bio-pesticides and soft/safe synthetic chemicals such as Nimbecidine; Achook, Neemroc <p>Chemical Control</p> <ul style="list-style-type: none"> • Spray using products based on Abamectin or Abamectin + Acetamiprid, bifenthrin, imidacloprid or Clofentezine.
Justification	<p>Currently there is indiscriminate overuse of synthetic insecticides to control leaf miners, leading to traces of pesticide residues in the crop, thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in the spider mite management will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment.</p> <p>Soft synthetic pesticides are recommended as a last option and their use should be minimized. Adoption of an IPM approach would minimize overuse of synthetic pesticides, enhance food safety and increase productivity and incomes for farmers.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma

Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5,000 as costs for insecticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 25,000


	(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 10-30% of KES 210,000 (i.e. a loss of 21,000-63,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication

	<ul style="list-style-type: none"> Well-organized friendly IPM trading conditions Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories of resistant varieties such P4, K218 and K235 being grown in pyrethrum growing areas.
Application guidelines for users	<ol style="list-style-type: none"> Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100-20106 Molo Email: kalro.molo@kalro.org</p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 - 00800.Nairobi Email: cd.narl@kalro.org</p> <p><u>KALRO Call Center: 0111010100</u></p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of Bio-control options for leaf miner
- Explore the efficacy of ITKs in management of pest

2.10.5. Integrated Pest Management of Scales (Management practice)

2.10.5. TIMP name	Integrated Pest Management of Scales
	 <p><i>Scale insects on the stem (infor.net)</i></p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Pyrethrin quality and yield loss of 30-50% due to pyrethrum plant damage.
What is it? (TIMP description)	<p>Integrated management of scales includes a combination of cultural practices, bio-control and chemical control options as follows:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Avoid planting new crop next to an infested field • Avoid continuous cropping of pyrethrum and solanacea plants (potato, tomato eggplant, nightshades) in the same field • Practise good crop hygiene by removal of infested plants and destroying by burning • Provide alternative habitats by conserving flowering plants at the borders of the field to promote natural enemies • Use clean seedlings free from scales • Prune out light infestations and burn the parts • Spray the infested plant part with a mild solution of water with dish-washing detergent at rate of 1 tea spoonful of detergent in 1 litre of water. <p>Biological control</p> <ul style="list-style-type: none"> • Use products like Beauvitech® WP or Lecatech® WP every 5 – 7 days with 2 – 4 repeat applications. <p>Chemical control</p> <ul style="list-style-type: none"> • spray with Paraffin oil 98% e.g. Segatron Ultra liquid and synthetic pesticides e.g. Closer 240SC, Engeo 247 SC, Shield 600 FS, Amazing Top WDG.
Justification	Currently most farmers are using a lot of synthetic pesticides in the management of this pest leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in the management of this pest will offer farmers several

	management options such as cultural and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies and CGIARs producing bio-pesticide/biological products, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents (e.g. Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	

Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5,000 as costs for insecticides and application per acre per season and



	<p>KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 30-50% of KES 210,000 (i.e. a loss of 63,000-105,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account

VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. 4. Causal agent of Pyrethrum Wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. 5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 – 20106 Molo Email: kalro.molo@kalro.org</p> <p>2)The Centre Director, KALRO-Kabete P.O. Box 14733 - 00800.Nairobi Email: cd.narl@kalro.org</p> <p><u>KALRO Call Center: 0111010100</u></p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of Bio-control options for leaf miners
- Explore the efficacy of ITKs in management of pest

2.10.6. Integrated Pest Management of Moles in Pyrethrum (Management practice)

2.10.6. TIMP name			Integrated Pest Management of Moles in Pyrethrum		
			<div><p><i>Mole</i></p></div> <div><p><i>Damage of mole rat in the field</i></p></div>		
Category (i.e. technology, innovation or management practice)			Management practice		
A: Description of the technology, innovation or management practice					
Problem addressed			Yield loss of 30-100% to pyrethrum plants due to physical feeding on the plant.		
What is it? (TIMP description)			Integrated management of moles involves a myriad of management options. This includes a combination of using traps and decoy baits and erecting water barriers around the pyrethrum fields. Removal of weeds in the farm and clearing the bushy areas around the fields to reduce habitat areas to reduce the populations of moles attacking the crop.		
Justification			Currently most farmers are using a lot of synthetic pesticides in form of baits a repellent to keep away moles from the crop. This leads to high pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in the management of this pest will offer farmers several management options that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.		
B: Assessment of dissemination and scaling up/out approaches					
Users of TIMP			Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing traps and decoy baits, Agrochemical dealers, Traders, Agripreneurs, Processors, Seed dealers, Researchers.		
Approaches to be used in dissemination			<ul style="list-style-type: none">Farmer Field and Business School (FFBS)Agricultural innovation platforms (AIP)Demonstrations - On-farm and on-stationAgricultural shows/exhibitions/field daysTrainings - workshops/Seminars/MeetingsPublic and private Extension Agents		

	<ul style="list-style-type: none"> • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations, to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the traps and decoy baits in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety.

	<ul style="list-style-type: none"> • Availing resources for dissemination • Making traps and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of mole traps and decoy baits near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5,000 as costs for mole baits and application per acre per season; KES 4000 per acre for mole traps. KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 29,000
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 30-100% of KES 210,000 (i.e. a loss of 63,000-210,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting and weeding which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPM



	<p>inputs</p> <ul style="list-style-type: none"> • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPM inputs such as mole trapping and baiting • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well organized friendly IPM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	Clearing bushes around pyrethrum fields and mole trapping afford good control, reduce crop damage, good crop stand, and therefore sustainable yields.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept

	<p>2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr.</p> <p>4. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi.</p> <p>5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)</p>
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100-20106 Molo Email: kalro.molo@kalro.org</p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 - 00800.Nairobi Email: cd.narl@kalro.org</p> <p><u>KALRO Call Center: 0111010100</u></p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of Bio-control options for moles
- Explore the efficacy of ITKs in management of pest

2.10.7 Integrated Disease management of Wilts (*Fusarium oxysporum*, *Fusarium solani*, *Rhizoctonia solani*, *Sclerotinia* spp.) (Management practice)

2.10.7 TIMP name	Integrated Disease management of Wilts (<i>Fusarium oxysporum</i>, <i>Fusarium solani</i>, <i>Rhizoctonia solani</i>, <i>Sclerotinia</i> spp.)		
			
		<i>Wilting of pyrethrum plants in</i>	<i>Wilted pyrethrum plant</i>

		<i>the field (Janet Obanyi, 2022)</i>	<i>(Janet Obanyi, 2022)</i>	
Category (i.e. technology, innovation or management practice)	Management practice			
A: Description of the technology, innovation or management practice				
Problem addressed	Pyrethrum yield loss of upto 100% due to infection, drying and eventual death of the pyrethrum crop			
What is it? (TIMP description)	<p>Integrated management of Fusarium wilt disease includes a combination of cultural, biological and chemical control practices as follows:</p> <p>Cultural practices</p> <ul style="list-style-type: none">• Plant using healthy clean splits, tissue culture or tolerant varieties such as P4, K218 and K235• Practise crop rotation with maize and/or legumes for 4 - 5 seasons• Practise good field hygiene, uproot infected plants and burn• Prevent surface runoff by digging trenches to avoid the spread of the disease. <p>Biological control</p> <ul style="list-style-type: none">• Use Trichoderma-based products (e.g. Trichotech, Rootgard, Trianum-P 11.5 WP, Eco T)• In severe infections, spray or drench using carbendazim-based products such as Rodazim SC, Bendazim SC, Sherrif 75WP and Propamocarb hydrochloride products such as Previcur N according to the manufacturers recommendations			
Justification	<p>Currently most farmers are indiscriminately using synthetic pesticides in the management of this wilt disease without proper guidance leading to traces of pesticide residues in the crop and also without alternatives ways of dealing with the disease, thus affecting the quality of pyrethrins. The use of integrated disease management (IDM) methods in the management of the wilt disease will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment.</p> <p>Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IDM approach would enhance food safety among the consumers and also contribute to environmental safety</p>			
B: Assessment of dissemination and scaling up/out approaches				
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.			
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on-station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings			



	<ul style="list-style-type: none"> • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied Research to test, validate the suggested IDM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IDM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. (Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IDM and the benefits to

challenges	<p>human health / food safety and environmental conservation and safety.</p> <ul style="list-style-type: none"> • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IDM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IDM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IDM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IDM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IDM strategies. • Harmonious gender consideration in research, consumption and marketing of IDM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IDM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for fungicides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IDM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IDM package lose 100% of KES 210,000-300,00 (i.e. a loss of 210,000-300,000)KES (Depending on levels of infestation, weather conditions and stage at which the disease infected the crop)</p>

Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IDM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IDM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IDM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IDM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IDM dissemination methods and documents that are not always easy to understand or access • Low access to IDM sources • Financial constraints • Integrated management of the pest and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IDM strategies for pyrethrum • Make friendly IDM training materials with illustrations to enhance communication • Well-organized friendly IDM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi.

	<p>3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; <i>In Plant Diseases American Phytopathology</i>, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr.</p> <p>4. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi.</p> <p>5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)</p>
F: Status of TIMP readiness (e.g. 1- Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

2.10.8 Integrated Disease Management of True Bud Disease (*Ascochyta* sp., *Alternaria* sp., *Ramularia bellunensis*) (Management practice)

2.10.8 TIMP name	Integrated Disease Management of True bud disease (<i>Ascochyta</i> sp., <i>Alternaria</i> sp., <i>Ramularia bellunensis</i>)		
			
	<i>True Bud Disease of pyrethrum</i> (Janet Obanyi, 2022)	<i>True Bud Disease of pyrethrum</i> (Janet Obanyi, 2022)	
Category (i.e. technology,	Management practice		

innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Significant yield loss of 30 - 100% and reduced quality of pyrethrins content due to disease infection of the crop
What is it? (TIMP description)	<p>Integrated management of true bud disease involves the combination of cultural practices, bio-control and chemical control as follows:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Use certified seed/splits/seedlings • Practice crop rotation with maize and or legumes for 2 - 3 seasons • Plough crop residues 2 feet deep after completion of the crop cycle • Remove crop residues from the field after completion of the crop cycle • Remove weeds and volunteer plants that carry over the pathogen from season to season <p>Chemical control</p> <ul style="list-style-type: none"> • Spray plantlets or seedlings or plants with Azoxystrobin-based products such as Azoxy Top 325SC and Carbendazim-based products such as Rodazim 500SC at rates recommended by the manufacturers.
Justification	<p>Currently most farmers indiscriminately overspray synthetic pesticides in the management of bud disease leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of integrated disease management methods in the management of the disease will offer farmers several management options such as cultural measures and bio-pesticides that are relatively safe to both human and environment.</p> <p>Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IDM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models

	<ul style="list-style-type: none"> • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IDM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IDM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents (e.g. Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IDM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination

	<ul style="list-style-type: none"> • Making traps, biopesticides and biologicals available and accessible • Research to develop more IDM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IDM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IDM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IDM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IDM strategies. • Harmonious gender consideration in research, consumption and marketing of IDM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IDM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for fungicides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IDM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000 - 300,000</p> <p>Farmers who do not use the IDM package lose 30 - 100% of KES 210,000 (i.e. a loss of 63,000 - 210,000)KES (depending on levels of infestation, weather conditions and stage at which the disease infected the crop)</p>
Gender issues and concerns in development, dissemination	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth

adoption and scaling up	<ul style="list-style-type: none"> • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IDM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IDM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IDM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IDM in disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IDM dissemination methods and documents that are not always easy to understand or access • Low access to IDM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IDM strategies for pyrethrum • Make friendly IDM training materials with illustrations to enhance communication • Well-organized friendly IDM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyn Imbwanga. Pyrethrum

	<p>Processing Company of Kenya limited.</p> <p>2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi.</p> <p>3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr.</p> <p>4. Causal agent of pyrethrum wilt and factors influencing the disease development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi.</p> <p>5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)</p>
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD, Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of bio-control options for true bud disease
- Explore the use of ITKs in disease management
- Evaluate new pyrethrum varieties for disease tolerance

2.10.9 Integrated Disease Management of False Flower Bud Disease (*Aphelenchoides ritsema-bosi*) and Frost (Management practice)

2.10.9 TIMP name	Integrated Disease Management of False Flower Bud Disease (<i>Aphelenchoides ritsema-bosi</i>) and Frost
Category (i.e. technology,	Management practice

innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of 10 - 30% due to false bud disease infection and frost
What is it? (TIMP description)	Integrated management of false bud disease is the combination of a myriad of strategies to control causal agents (frost and nematodes); use of sprinkler irrigation on young plants if they are affected by frost. Integrated Pest Management of nematodes if affected by nematodes using cultural practices like crop rotation with crops in the grass family for 4-6 seasons, prevention of surface run off to avoid spread of the pest to non-infected areas, uprooting and burning affected plants, soil solarization by exposing soil to high temperatures during dry months. Chemical control by use of biopesticides (Achook, Nimbecidine and Triatum P.) according to the manufacturer's recommendation.
Justification	Currently most farmers are spraying a lot of synthetic pesticides in the management of this disease leading to pesticide residues in the crop, thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in the management of this disease will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an integrated pest and disease management (IPDM) approach would enhance food safety among the consumers and also contribute to environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IPDM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks

	<ul style="list-style-type: none"> • Good Extension models in promotion of IPDM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents (e.g. Chiefs), Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPDM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IPDM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production

	<p>and marketing</p> <ul style="list-style-type: none"> • Develop good policy for the use of IPDM in management of pest Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPDM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPDM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPDM strategies. • Harmonious gender consideration in research, consumption and marketing of IPDM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPDM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for pesticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPDM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPDM package lose 30-100% of KES 210,000 (i.e. a loss of 63,000-210,000)KES (Depending on levels of infestation, weather conditions and stage at which the disease infected the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPDM inputs • Slow information and awareness flow to female farmers due to academic levels


	<ul style="list-style-type: none"> • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPDM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPDM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPDM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPDM dissemination methods and documents that are not always easy to understand or access • Low access to IPDM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPDM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPDM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyn Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent,

	<p>Forrest W. Nutter, Jr.</p> <p>4. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi.</p> <p>5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)</p>
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org</p>
Lead organization and scientists	<p>KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.</p>
Partner organizations	Real IPM, Dudutech, MoALD, Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of Bio-control options for false flower bud disease
- Explore the efficacy of ITKs in management of the disease
- Evaluate new pyrethrum varieties for disease tolerance

2.10.10 Integrated Management of Root Knot Nematode (*Meloidogyne* spp.) (Management practice)

2.10.10 TIMP name	Integrated Management of Root Knot Nematode (<i>Meloidogyne</i> spp.)
	 <p>Root knot nematode (<i>Meloidogyne</i> spp.)</p>

	(Source: Miriam Otipa, KALRO)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Significant crop loss of up to 100% due to nematode damage on the pyrethrum roots
What is it? (TIMP description)	<p>Integrated management of root knot nematodes is a combination of cultural practices, biopesticides, biological control and synthetic insecticides to control the pest.</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Planting clean / certified planting materials • Removal and destruction of infected crops • Practising crop rotation for a period of at least 6-8 weeks • Avoid planting young next to an older infected crop or an alternative host crop • Removal of weeds that serve as alternative hosts and harbour the pest season after season • Intercrop with garlic/spider plant or with brassica crops kales and canola then incorporate into the soil (at flowering) as they kill the pest • Plough fields deeply to expose soil to sunshine for a month before planting • Disinfect planting splits or seedlings before planting using hot water treatment (soak for 10 minutes in water at 50 degrees centigrades) • Wash off soil on all farm tools and disinfect using approved chlorine based products. <p>Biological control</p> <ul style="list-style-type: none"> • Drenching with Azadirachtin (Neemark, Nemros, Achook), Nimbecidine or use of Beauvitech WP (<i>Beauveria bassiana</i>) or Bio-Power (<i>Beauveria bassiana</i>), or Botanigard (Azadirachtin). <p>Chemical control</p> <ul style="list-style-type: none"> • use of products based on Abamectin or Abamectin + Fosthiazate or Dazomet around the root zone of the plant.
Justification	<p>Currently most farmers indiscriminately apply synthetic pesticides in the management of the nematodes leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Pest Management methods in the management of this pest will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment.</p> <p>Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to</p>

	environmental safety.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media - Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied Research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma

Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making biopesticides and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5,000 as costs for nematicides and application per acre per season and KES 20,000 as labor and other costs for implementation

	<p>of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 100% of KES 210,000- 300,000(i.e. a loss of 210,000-300,000)KES (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces



	production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. 4. Causal agent of pyrethrum wilt and factors influencing the disease's development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. 5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD, Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of biocontrol options for root knot nematodes

- Explore the efficacy of ITKs in management of nematode
- Evaluate new pyrethrum varieties for tolerance to root knot nematodes

2.10.11 Integrated Management of Lesion nematodes (*Pratylenchus* spp.) (Management practice)

2.10.11 TIMP name		Integrated Management of Lesion nematodes (<i>Pratylenchus</i> spp.)	
			
	<i>Field with patches showing nematode infestation</i>	<i>Lesion nematode infestation on pyrethrum roots</i>	
Category (i.e. technology, innovation or management practice)	Management practice		
A: Description of the technology, innovation or management practice			
Problem addressed	Yield loss of 10 - 50% due to pest damage on pyrethrum crop roots		
What is it? (TIMP description)	<p>Integrated management of the lesion nematode includes a combination of cultural methods, biopesticides, biological control and synthetic insecticides to control pest.</p> <p>Cultural practices</p> <ul style="list-style-type: none">• Planting clean/certified planting material• Removal and destruction of infected crops• Practising crop rotation for a period of at least 6-8 weeks• Avoid planting young next to an older infected crop or an alternative host crop• Removal of weeds that serve as alternative hosts and harbour the pest season after season• Intercrop with garlic/spider plant or with brassica crops kales and canola then incorporate into the soil (at flowering) to kill the pest• Plough fields deeply to expose soil to sunshine for a month before planting• Disinfect planting splits/seedlings before planting using hot water treatment (soak for 10 minutes in water at 50 degrees Centigrade)• Wash off soil on all farm tools and disinfect using approved chlorine based products. <p>Biological control</p> <ul style="list-style-type: none">• Drench with Azadirachtin (e.g. Neemark, Nemros, Achook),		

	<p>Nimbecidine or use of Beauvitech WP (<i>Beauveria bassiana</i>) or Bio-Power (<i>Beauveria bassiana</i>) or Botanigard (Azadirachtin).</p> <p>Chemical control</p> <ul style="list-style-type: none"> • Use of products based on Abamectin or Abamectin + Fosthiazate or Dazomet around the root zone of the plant.
Justification	<p>Currently most farmers apply pesticides indiscriminately in the management of lesion nematodes leading to pesticide residues in the crop thus affecting the quality of pyrethrins.</p> <p>The use of Integrated Pest Management methods in the management of this pest will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment.</p> <p>Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IPM strategies • A platform for pyrethrum value chain stakeholders to interact • Well organized farmer groups and networks • Good Extension models in promotion of IPM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya

	<ul style="list-style-type: none"> • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IPM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IPM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IPM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IPM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IPM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to

scaling	<p>market requirements</p> <ul style="list-style-type: none"> • Creation of awareness on importance of IPM strategies. • Harmonious gender consideration in research, consumption and marketing of IPM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IPM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for pesticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IPM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IPM package lose 10-50% of KES 210,000 (i.e. a loss of KES 21,000 - 105,000), depending on levels of infestation, weather conditions and stage at which the pest affects the crop.</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IPM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IPM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IPM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth


	<ul style="list-style-type: none"> • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IPM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IPM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IPM strategies for pyrethrum • Make friendly IPM training materials with illustrations to enhance communication • Well-organized friendly IPM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyn Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. 4. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. 5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete</p>

	P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org
Lead organization and scientists	KALRO Otipa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of biocontrol options for lesion nematodes
- Explore the efficacy of ITKs in management of lesion nematodes
- Evaluate new pyrethrum varieties for nematode tolerance

2.10.12 Integrated Disease Management of Crown Rot Diseases (*Fusarium* spp., *Rhizoctonia* spp. *Sclerotinia minor*, *Ascochyta* spp.) (Management practice)

2.10.12 TIMP name	Integrated Disease Management of Crown Rot Diseases (<i>Fusarium</i> spp., <i>Rhizoctonia</i> spp. <i>Sclerotinia minor</i> , <i>Ascochyta</i> spp.)
	 <p>Crown rot disease symptoms</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of 30 - 60% caused by fungi which remain in pyrethrum stalks and become a source of disease infections in subsequent seasons.
What is it? (TIMP description)	<p>Integrated management of the crown rot is the use of cultural practices, bio-control and chemical control which include:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Planting certified seed or splits • Practising crop rotation with legumes for at 2-3 season

	<ul style="list-style-type: none"> • Avoiding overhead irrigation to reduce splash of pathogen to healthy plants • Uprooting and destroyin of severely affected plants & burying or burning them. <p>Biological control</p> <ul style="list-style-type: none"> • Drenching with Azadirachtin (Neemark, Nemros, Achook), Nimbecidine or use of Beauvitech WP (<i>Beauveria bassiana</i>) or Bio-Power (<i>Beauveria bassiana</i>) or Botanigard (Azadirachtin). <p>Chemical control</p> <ul style="list-style-type: none"> • Use of carbendazim- or azoxystrobin-based products e.g. Bendazim and Ortiva according to the manufacturer's recommendation.
Justification	<p>Currently most farmers over use synthetic pesticides indiscriminately in the management of this disease leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Disease Management methods in the management of this disease will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IDM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IDM strategies • A platform for pyrethrum value chain stakeholders to interact • Well organized farmer groups and network • Good Extension models in promotion of IDM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension /

	companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IPM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IDM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making traps, biopesticides and biologicals available and accessible • Research to develop more IDM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IDM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling,	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value

if any	<p>chain stakeholders collaborate in an innovation platform</p> <ul style="list-style-type: none"> • Farmers are receptive to the IDM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IDM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IDM strategies. • Harmonious gender consideration in research, consumption and marketing of IDM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IDM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for pesticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IDM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IDM package lose 30 - 60% of KES 210,000 (i.e. a loss of 63,000 - 126,000)KES (Depending on levels of infestation, weather conditions and stage at which the disease infected the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IDM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers

Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IDM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IDM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IDM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IDM dissemination methods and documents that are not always easy to understand or access • Low access to IDM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IDM strategies for pyrethrum • Make friendly IDM training materials with illustrations to enhance communication • Well-organized friendly IDM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyn Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esler, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. 4. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in

	Agriculture, University of Nairobi. 5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u> 2) The Centre Director, KALRO-Kabete P.O. Box 14733 - 00800 Nairobi Email: cd.narl@kalro.org
Lead organization and scientists	KALRO Otupa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of biocontrol options for crown rot disease
- Explore the efficacy of ITKs in disease management
- Evaluate new pyrethrum varieties for crown rot disease tolerance

2.10.13 Integrated Disease Management of Flower blight (*Sclerotinia sclerotiorum*, *Phoma* spp., *Alternaria* spp., *Botrytis cinerea*) (Management practice)

2.10.13 TIMP name	Integrated DiseaseManagement of Flower blight (<i>Sclerotinia sclerotiorum</i>, <i>Phoma</i> spp., <i>Alternaria</i> spp., <i>Botrytis cinerea</i>)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of up to 40% due to the fungal infection on the crop flower
What is it? (TIMP description)	Integrated management of flower blight fungi involves the use of cultural practices, bio-control and chemical control which include: Cultural practices <ul style="list-style-type: none"> • Use of certified seed or splits, practising crop rotation with non-legume crops for 3-4 seasons • Uprooting and destroying infected plants/volunteers by burying or burning

	<ul style="list-style-type: none"> Disinfecting farm tools in jik solution (50ml/litre) and avoidance of working in wet fields <p>Biological control</p> <ul style="list-style-type: none"> Use of Trichoderma-based products e.g Trichotech, Rootgard, Trianum-P 11.5 WP, Eco T. <p>Chemical control</p> <ul style="list-style-type: none"> Spraying with carbendazim-based products such as Rodazim SC, Bendazim, Sherrif, or Propamocarb hydrochloride products such as Previcur according to the manufacturers' recommendations
Justification	<p>Currently most farmers are using a lot of synthetic pesticides in the management of this disease leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Disease Management methods in the management of this disease will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IDM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on-station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer-to-farmer extension models Mass media – Electronic and print Publications - posters/brochures/leaflets, manuals Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Applied research to test, validate the suggested IDM strategies A platform for pyrethrum value chain stakeholders to interact Well-organized farmer groups and networks Good Extension models in promotion of IDM strategies County and national government support Funding to research, validate and promote new biopesticides A strong partnership between technical personnel / extension / companies producing biologicals and biopesticides and farmers would enhance promotion.

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IDM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IDM and the benefits to human health/food safety and environmental conservation and safety. • Availing resources for dissemination • Making biopesticides and biologicals available and accessible • Research to develop more IDM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IDM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Farmers are receptive to the IDM technology once sensitized

	<ul style="list-style-type: none"> • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IDM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IDM strategies. • Harmonious gender consideration in research, consumption and marketing of IDM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IDM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for insecticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IDM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000- 300,000</p> <p>Farmers who do not use the IDM package lose 40% of KES 210,000 - 300,000 (i.e. a loss of 84,000 - 150,000)KES (Depending on levels of infestation, weather conditions and stage at which the disease infected the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IDM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IDM protocols are possible with little technical knowledge for various operations.

	<ul style="list-style-type: none"> • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IDM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IDM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IPM dissemination methods and documents that are not always easy to understand or access • Low access to IDM sources • Financial constraints • Integrated management of pests and diseases reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IDM strategies for pyrethrum • Make friendly IDM training materials with illustrations to enhance communication • Well-organized friendly IDM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	There are success stories if tolerant clones and varieties such P4, K218 and K235 are grown under hygienic conditions.
Application guidelines for users	<ol style="list-style-type: none"> 1. Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyn Imbwanga. Pyrethrum Processing Company of Kenya limited. 2. Kenya Pyrethrum Compendium. 2022. Janet Obanyi. 3. Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. 4. Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. 5. Pest Control Products Board List of registered products (https://www.pcpb.go.ke/on-crops/)

F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO Otupa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of biocontrol options for flower blight disease
- Explore the efficacy of ITKs in management of the disease
- Evaluate new pyrethrum varieties for flower blight disease tolerance

20.10.14 Integrated Disease Management of Tomato Spotted Wilt Virus (TSWV) (Management practice)

20.10.14 TIMP name	Integrated Disease Management of Tomato Spotted Wilt Virus (TSWV)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of 10 - 30% if the virus infects the pyrethrum crop leaves in the early stages of the crop growth
What is it? (TIMP description)	<p>Integrated management of the disease involves the use of cultural practices, bio-control and chemical control which include:</p> <p>Cultural practices</p> <ul style="list-style-type: none"> • Use of virus-free planting materials (seed, seedlings, plantlets, cuttings) • Wash hands with soap and water before/during plant handling to reduce the spread of virus between plants • Remove weeds from and around the crop fields, as these may be alternate hosts for virus vectors • Use reflective mulches (aluminum or silver-coloured) placed in rows to reduce whitefly feeding at the end of the crop cycle

	<ul style="list-style-type: none"> • Burn or bury all diseased plants • Disinfect farm tools and any other equipment between growing seasons using commercial bleach (e.g. Jik) or other disinfectants • Intercrop with plants like onions, chives and garlic or plant trap and repellent crops around the target crop to control virus vectors <p>Biological Control</p> <ul style="list-style-type: none"> • Use sticky traps to control vector populations <p>Chemical Control</p> <ul style="list-style-type: none"> • Applying appropriate insecticides such as deltamethrin, imidacloprid, cypermethrin and neonicotinoid-based products (e.g. Actara, Decis, Thunder and Duduthrin) to control insect vectors.
Justification	<p>Currently most farmers over use synthetic pesticides indiscriminately in the management of this disease leading to pesticide residues in the crop thus affecting the quality of pyrethrins. The use of Integrated Disease Management methods in the management of this disease will offer farmers several management options such as cultural and bio-pesticides that are relatively safe to both human and environment. Soft synthetic pesticides are recommended as a last option to minimize their overuse. Adoption of an IDM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents (Public and Private), Research Organizations and Universities, Companies producing bio-pesticide/biological products as well as CGIAR's, Agrochemical dealers, Traders, Agripreneurs, Millers, Seed dealers, Researchers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied research to test, validate the suggested IDM strategies • A platform for pyrethrum value chain stakeholders to interact • Well-organized farmer groups and networks • Good Extension models in promotion of IDM strategies • County and national government support • Funding to research, validate and promote new biopesticides • A strong partnership between technical personnel / extension /

	companies producing biologicals and biopesticides and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to provide variety, seed and production information • Pyrethrum Processing Company of Kenya • Market players to create a demand and encourage production • Farmers/farmer groups to adopt and produce • County governments, national government agents e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to take up pyrethrum e.g. Real IDM, Farm Africa for farmer organization and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Convincing farmers to use an integrated approach other than rushing to use synthetic pesticides. • Availing the biopesticides in agro-input outlets closer to the farmers and at affordable pyrethrums • Low use of good agricultural practices
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms • Training farmers on the advantages of using IDM and the benefits to human health / food safety and environmental conservation and safety. • Availing resources for dissemination • Making biopesticides and biologicals available and accessible • Research to develop more IDM technologies • Information dissemination on production practices • Promotion of IPM practices in the suitable areas • Promote marketing models that encourage collective production and marketing • Develop good policy for the use of IDM in management of pest • Involve County governments, extension, marketers and processors
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform

	<ul style="list-style-type: none"> • Farmers are receptive to the IDM technology once sensitized • Creation of awareness through demonstrations and farmer workshops helps in adoption of the IDM practices • Availability of biopesticides near farmers is key
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Environmental safety considerations since it minimizes pesticides in produce • Minimization of use of synthetic chemical spray options will prevent elimination of non-target organisms. The produce will conform to market requirements • Creation of awareness on importance of IDM strategies. • Harmonious gender consideration in research, consumption and marketing of IDM strategies. It is cultivated mainly by women hence the need to capacity build them. • It is already “a climate change ready management practice” due to its wide adaptation ability. • Enabling IDM policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>KES 5,000 as costs for insecticides and application per acre per season and KES 20,000 as labor and other costs for implementation of the integrated management practices in the IDM package per acre/season. Total basic costs; KES 25,000</p> <p>(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)</p>
Estimated returns	<p>Estimated returns (600kg dry flowers x KES 350/kg-500)/acre/year = KES 210,000 - 300,000</p> <p>Farmers who do not use the IDM package lose 10 - 30% of KES 210,000 (i.e. a loss of KES 21,000 - 63,000), depending on levels of infestation, weather conditions and stage at which the disease infection the crop</p>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Labour intensity in planting, weeding, spraying which are mostly done by women and youth • Land ownership mainly by men who may have no interest in pyrethrum • Financial empowerment - the poor farmers lack funds to acquire IDM inputs • Slow information and awareness flow to female farmers due to academic levels • Women and youth may not be able to reach far way markets or have bargaining power • Lack of youth opportunities in pyrethrum value chain • The training materials and strategies may not be favorable to women farmers

Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youth employment in implementing IDM protocols are possible with little technical knowledge for various operations. • Women and youth friendly production techniques such as mechanization • Empower women and youth to acquire land and IDM inputs such as pesticides • Reach more women groups with the pyrethrum information • Well-organized gender friendly markets and marketing system • Apply enterprising mechanized, marketing and value addition channels for the youth • Make gender friendly training materials with illustrations to enhance communication to all gender • Use the FFBS strategy for effective training of farmer groups on use of IDM in pest and disease management
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Laborious pest and disease management practices • IDM dissemination methods and documents that are not always easy to understand or access • Low access to IDM sources • Financial constraints • Integrated management of the pest and disease reduces production costs therefore VMG's can afford to produce pyrethrum with low-income inputs. Safety of VMG's is taken into account
VMG related opportunities	<ul style="list-style-type: none"> • Affordable IDM strategies for pyrethrum • Make friendly IDM training materials with illustrations to enhance communication • Well-organized friendly IDM trading conditions • Empower the VMGs by connecting them to financial sources
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	<ul style="list-style-type: none"> • Increasing pyrethrum yields by planting the right material for your area. 2022. Brochure. Carolyne Imbwanga. Pyrethrum Processing Company of Kenya limited. • Kenya Pyrethrum Compendium. 2022. Janet Obanyi. • Diseases of pyrethrum in Tasmania: Challenges and Prospects for management; In Plant Diseases American Phytopathology, Sept 2008. Sarah J. Pethybridge, Frank S. Hay Paul Esker, Calum Wilson, Tim Groom, David H. Gent, Forrest W. Nutter, Jr. • Causal agent of pyrethrum wilt and factors influencing the diseases development. 1997. Kinyua Z.M. MSc. Thesis in Agriculture, University of Nairobi. • Pest Control Products Board List of registered products


	(https://www.pcpb.go.ke/on-crops/)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 – 20106 Molo Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Centre Director, KALRO-Kabete P.O. Box 14733 – 00800 Nairobi Email: cd.narl@kalro.org</p>
Lead organization and scientists	<p>KALRO Otupa, M., Obanyi J., Mulwa J., Amata R., Kirigua, V.O., Wasilwa, L.</p>
Partner organizations	Real IPM, Dudutech, MoALD , Agricultural Universities and Colleges, ICIPE, CABI, Koopert Biological Systems Ltd, County governments, NGOs and Formulators, Processors

Gaps:

- Explore use of biocontrol options for TSWV disease
- Explore the efficacy of ITKs in disease management
- Evaluate new pyrethrum varieties for TSWV disease tolerance

2.11 WEED MANAGEMENT IN PYRETHRUM

2.11.1 Integrated Management of Weeds in Pyrethrum (Management practice)

2.11.1 TIMP Name	Integrated Management of Weeds in Pyrethrum
Crop management practices	Management practice
A: Description of the technology, innovation or management practice	
	 <p><i>Pyrethrum field infested by weeds</i></p>
Problem to be addressed	Low and poor quality yields of pyrethrum due to competition from different annual and perennial weed species combined with poor weed management approaches.

	<p>Weeds of economic importance include wandering jew (<i>Commelina benghalensis</i>), African couch grass (<i>Digitaria abyssinica</i>), Oxalis (<i>Oxalis latifolia</i>), sedges such as Yellow nutsedge (<i>Cyperus esculentus</i>) and Purple nutsedge (<i>Cyperus rotundus</i>), Kikuyu grass and Portulaca (<i>Potulaca Oleraceae</i>), Cleavers/ catchweed bedstraw (<i>Galium aparine</i> L.) and white clover (<i>Trifolium repens</i> L.). Emerging weeds include Double thorn (<i>Oxygonum sinuatum</i> and devil's thorn (<i>Emex australis</i>)</p>
What is it? (TIMP description)	<p>Integrated Weed Management (IWM) is the control of weeds by use of several approaches since one method may effectively control some weed species but not others. Approaches include cultural, mechanical, and chemical (before planting pyrethrum), among others. One has to start with the most environmentally friendly (cultural) strategy as you move towards harsh (chemical) control methods.</p> <p>Cultural/ mechanical control involves removal of weeds manually by practices such as tillage, hand weeding or mowing. In manual weeding, weeds are removed frequently to ensure the pyrethrum is weed free as possible.</p> <p>Chemical control refers to any technique that involves the application of herbicides on weeds or soil to control the growth or germination of the weed species. A post-emergence herbicide such as glyphosate or paraquat may be applied to kill young weeds during land preparation, or a pre-emergence such as sencor on the soil.</p> <p>Note: Application should be done 2-3 weeks before planting pyrethrum to prevent detection of herbicide residues in the crop. The recommended rate is 0.6 kg metribuzin/ha (as Sencor) or bentazone or atrazine.</p> <p>The first thing to do is to monitor fields, identify species and maintain records of where and when they occur in each field. This would guide on the management approaches to combine, when and where they are likely to appear.</p>
Justification	<p>Pyrethrum is vulnerable to weed invasion particularly in young stages of the crop, hence fields must always be kept weed-free. Weeds can drastically reduce flower yields by interfering with tiller development and may kill the pyrethrum crop if not managed by the third month. There is therefore the need to do Integrated Weed Management frequently, after every 4 weeks. Herbicides, when appropriately used, could effectively control weeds at the same time increase yields. This TIMP provides various IWM approaches that could manage diverse weeds in pyrethrum cropping systems.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension workers

Approaches used in dissemination	<ul style="list-style-type: none"> • Agro dealers • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • A platform for interaction of pyrethrum value chain stakeholders • Promotion and training on (IWM). • Addressing environmental and safety concerns related to the use of herbicides. • Promotions with demos and field days for farmer groups and stakeholders on effectiveness of the various weed management options using FFBS approach. • Training of stakeholders on biology, weed dynamics and identification of weeds in cropping systems. • Farmer training on conservation of biodiversity by preservation of pollinators when using herbicides for increased productivity. • Training for users on appropriate use of herbicide and their safe use.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • KALRO to conduct further evaluations and advice on Technical issues • County governments and MoALD to provide extension services, farmer mobilization and policy formulation • Agrochemical companies and Agro-dealers to provide recommended herbicides and guidelines on their use • Relevant CBOs and NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Kisii and Nakuru Counties
Counties where TIMPs will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders. • Low use of Integrated Weed Management (IWM) and labour intensity. • Inadequate knowledge and information on herbicide types to use, how and when to use them • Detection of herbicide residues in the harvested pyrethrum .



Suggestion for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms to promote the technology by conducting demos and field days and involvement of stakeholder e.g. chemical companies and agro-dealers. • Develop information, e.g. manuals, pamphlets, on IWM and disseminate to various stakeholders through training using available methods, including. • Awareness creation on when and how to use herbicides in order to avoid residues in the pyrethrum.
Lesson learned in up scaling if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in innovation platforms • IWM approach is more effective than use of one control method. • Awareness creation through demonstrations and farmer field days could help in adoption of the technology/ IWM • Availability of market for the produce 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	<ul style="list-style-type: none"> • Train stakeholders to understand the effectiveness of IWM approach. • Address the environmental and social concerns related to use of herbicides. • A functional agro-dealer network to supply recommended herbicides when required by the farmers and also to have a safety plan such as disposal of containers and expired products when using herbicides.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Labour for timely weeding per acre (10 days @ KES 500) = KES 5,000.</p> <p>Cost of herbicide per acre plus spraying = KES 6,000</p> <p>Total labour cost = KES 11,000</p> <p>Labour reduced from 20 to 10 days when pre-emergence herbicides are used.</p>
Estimated returns	<p>Yield = 500 - 600kg dry flower per acre from 2nd year onwards</p> <p>Price per kg = KES 350.</p> <p>Total cash = (500 x 350) to (600 x 350) = KES 175,000 to 210,000.</p> <p>Estimated returns per acre per year = (175,000 - 16,000) to (210,000 - 11,000)</p> <p style="text-align: right;">= 164,000 to 199,000</p>
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Pyrethrum is owned by men yet its women and the youths who perform most of the weeding activities • Women and youths have limited access to productive resources such as land and chemicals • Women and youths have limited access to education, training and extension services . • Women have less access to agricultural information, technology

	and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for males and youth males in spraying the crop. • Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to productive resources such as land and chemicals . • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	Opportunities for training and marketing
E: Case studies/profiles of success stories	
Success stories	A combination of more than one weed management practices effectively controlled pyrethrum weeds in Kisii and Nakuru Counties
Application guidelines for users	<ol style="list-style-type: none"> 1. Wanjala, B. W. K. (1989). Weed control methods in pyrethrum production in Kenya, Pp.57. In: Adipala E. Tusiime, G. and Okori (eds.). 2. Proceedings of the 16th Biennial weed Science Society Conference for Eastern Africa. Kampala,Uganda.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation to ensure no residues remain in the produce before use
G: Contacts	
Contacts	Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Email: cd.narl@kalro.org
Lead organization and scientists	KALRO, Kabete Momanyi Violet and Hottensiah Mwangi
Partner organizations	KALRO, relevant NGOs, CBOs, County Governments, KEPHIS

Gaps: Requires validation to determine residual remains of herbicides in the produce, if any.

2.11.2 Pyrethrum Intercropping for Weed Management (Management practice)



2.11.2 TIMP Name	Pyrethrum Intercropping for Weed Management
Categories (i.e. technology innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be	Low and poor quality yields of pyrethrum due to competition for growth

addressed	resources such as nutrients from different annual and perennial weed species combined with poor weed management approaches.
What is it? (TIMP description)	<p>Intercropping for weed management in pyrethrum is the growing of two or more crops (such as beans and green grams) in a pyrethrum field at the same time to reduce weed infestation.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <p><i>Intercropping in a weeded crop</i></p> <p><i>Pyrethrum-legume intercrop</i></p> </div> <p>The intercropping arrangements may include mixed, strip and row-intercropping patterns. In row-intercropping, a legume is planted in-between rows of the pyrethrum crop.</p>
Justification	<p>Weeds can drastically reduce flower yields by interfering with tiller development and may kill the pyrethrum crop if not managed by the third month. Young pyrethrum crop is more vulnerable to weed invasion. Weeds reduce flower yields by interfering with tiller development and may kill the pyrethrum crop if not managed by the third month. Fields should always be kept weed-free.</p> <p>Intercropping legumes such as beans, green grams and mucuna with the main crop drastically reduces weed germination and establishment in the field. Planting legumes in-between rows forms a canopy that covers the soil. The canopy reduces soil temperature and light which does not favour weed germination and will also weaken the germinated weeds.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension workers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential	<ul style="list-style-type: none"> • Applied and adaptive research to upscale suitable legumes for

factors for successful promotion	<p>intercropping in pyrethrum cropping systems.</p> <ul style="list-style-type: none"> • A platform for interaction of pyrethrum value chain stakeholders • Promotion and training on intercropping systems in pyrethrum. • Promotion with demos and field days for farmer groups and stakeholders on effectiveness of the various intercropping using FFSB approach. • Training of stakeholders on biology, weed dynamics and identification of weeds in the cropping systems.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • KALRO to conduct further evaluations and advice on Technical issues • County governments and MoALD to provide extension services, farmer mobilization and policy formulation • Relevant CBOs and NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Kisii and Nyandarua Counties
Counties where TIMPs will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders. • Low use of intercropping • Labour intensity for the intercrops. • Inadequate knowledge and information on the right legume crop to intercrop with pyrethrum.
Suggestion for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms to promote the technology through demos, field days, FFS • Develop information, e.g. manuals, pamphlets, on intercropping and disseminate to various stakeholders. • Awareness creation on the right legume to use, when and how to intercrop.
Lesson learned in up scaling if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when value chain stakeholders collaborate in an innovation platform • Intercropping controls weeds better than planting pyrethrum mono crop • Awareness creation through demonstrations and farmer field days could help in adoption of intercropping. • Availability of market for the produce is essential • Partnership is important in dissemination and adoption of intercropping.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Train stakeholders to understand the effectiveness of IWM approach. • Intercropping to control weeds reduces the environmental and social concerns related to use of herbicides.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Labour cost for 2 land preparations using a sub-soiler is about KES 30,000 per acre</p> <p>Manual weeding without intercrop is about KES 12,000 per acre (12 casuals per day@ KES 500 for 2 weedings).</p>

	Manual weeding with intercrop is about KES 6,000 per acre (12 casuals per day@ KES 500 for one weeding). Second weeding not done. Legume ground cover prevents further weed germination and weakens growth of those that germinate.
Estimated returns	Yield per acre = 500 - 600kg dry flower from 2nd year onwards Cost per kg = KES 350. Total cash = (500 x 350) to (600 x 350) = KES 175,000 to 210,000. Estimated returns with intercrop is KES (175,000 – 42,000 labour) to (210,000 – 42,000 labour) = KES 133,000 to 168,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Weeding is mostly done by women and children. Dissemination strategies should target them more but also sensitize men and youths to understand the benefits of intercropping. • Intercropping can reduce labor spent on manual weeding. This could save time for other activities for women and children.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit • Weeding labour is reduced therefore opportunities exist for women and youth to get in other economic activities including the production and marketing.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMG groups could be having limitations in accessing the knowledge, resources and exposed to many threats such as insecurity and land disputes.
VMG related opportunities	Training for VMG on Intercropping practices and opportunities that may emerge
E: Case studies/profiles of success stories	
Success stories	Intercropping pyrethrum with beans, Mucuna, soya increased yields in Kisii and Nakuru Counties
Application guidelines for users	Use recommended agronomic practices for the intercropped crops
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Email: cd.narl@kalro.org
Lead organization and scientists	KALRO, Kabete Momanyi Violet and Hottensiah Mwangi
Partner organizations	KALRO, relevant NGOs, CBOs, County Governments, KEPHIS

2.11.3 Mulching for Weed Management in Pyrethrum (Management practice)

2.11.3 TIMP Name	Mulching for Weed Management in Pyrethrum
Categories (i.e. technology innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low and poor quality yields of pyrethrum resulting from competition for growth resources such as nutrients from diverse annual and perennial weed species combined with poor weed management approaches.
What is it? (TIMP description)	<p>The practice of covering the soil with natural or synthetic materials to prevent germination of weed seeds by using synthetic or natural mulches.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center;"><i>Mulched using maize stovers</i> <i>Mulched using hay</i></p> <p>Organic mulches include straw, grass and dead leaves while synthetic mulch include black polythene paper. Organic mulches should be between 2 - 4 inches deep to effectively prevent weed germination and suppress the growth in pyrethrum fields.</p>
Justification	<p>Young pyrethrum crop is vulnerable to weed invasion. Weeds reduce flower yields by interfering with tiller development and may kill the pyrethrum crop if not managed by the third month. Fields should always be kept weed-free.</p> <p>Mulches will prevent light from reaching the small weeds and seed germination thus will reduce their population. In addition, organic mulches facilitate retention of soil moisture there by controlling temperature fluctuations, improves physical, chemical and biological properties of soil by adding nutrients (when they rot) to the soil. This will enhance the growth and yield of pyrethrum. It also improves soil structure by preventing impact of raindrop (soil erosion) and indirectly by promoting biological activity.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension workers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days


	<ul style="list-style-type: none"> • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Adaptive research to upscale and release mulching technology in pyrethrum varieties • A platform for interaction of pyrethrum value chain stakeholders • Availability of plant or crop residues for organic mulches. • Size of the land. • Competing uses of crop residues. • Type and availability of the crop residues • Cost and availability of synthetic materials • Disposal of synthetic material after use.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • KALRO to conduct further evaluations and advice on Technical issues. • County governments and MoALD to provide extension services, farmer mobilization and policy formulation • Relevant CBOs and NGOs to provide micro financing services • County extension staffs
C: Current situation and future scaling up	
Counties where already promoted if any	Kisii and Nyandarua Counties
Counties where TIMPs will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in development and dissemination	<ul style="list-style-type: none"> • Low use of mulches especially synthetic because it may be costly • Labour intensity and availability of mulching materials. • Inadequate knowledge and information on the right mulch to use in pyrethrum cropping systems. • Lack of enough plant and crop residues due to competing uses of organic mulches with livestock. • Possibilities of insect pest build up or disease vectors in organic mulches. • Tears and rips which could allow weed emergence through mulches including around the holes.
Suggestion for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms to promote the technology through demos, field days, FFS • Develop information, e.g. manuals, pamphlets, on mulching technology and dissemination to various stakeholders. • Awareness creation on the type of mulch, when and how to use it. • Crop diversification to increase availability of organic mulches. • Adapting alternative mulching materials like high absorbance polymers.

	<ul style="list-style-type: none"> Monitoring any tears /rips and pulling out any weeds without allowing them to spread and take over.
Lesson learned in up scaling if any	<ul style="list-style-type: none"> Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform Mulching not only controls weeds but also improves the soil structure and fertility. Awareness creation through demonstrations and farmer field days could help in adoption of mulching. Availability of market for the produce is essential Partnership is important in dissemination and adoption of mulching technology. Mulching is environmentally friendly
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Train stakeholders to understand the effectiveness of mulching technology. Practice is socially acceptable and environment friendly Increased productivity will be sold readily to the existing markets Availability of supporting frameworks/ policies.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Cost for 2 land preparations using a sub-soiler is about KES 30,000 per acre. Cost of organic mulch is about KES 4,000, depending on the type. Mulching is about KES 2,000 per acre (2 casuals, 2 days @500) to mulch. Mulching reduces weeding labour cost from KES 12,000 (12 casuals, 2 weedings for one day @ 500) to KES 2,000 (uprooting few weeds that penetrate through mulches).</p> <p>Basic cost is KES 30,000 + 4,000 +2,000 = 36,000</p>
Estimated returns	<p>Yield per acre = 500 - 600kg dry flower from 2nd year onwards Cost per kg = KES 350. Total cash = (500 x 350) to (600 x 350) = KES 175,000 to 210,000.</p> <p>Estimated returns with intercrop is KES (175,000 – 36,000 labour) to (210,000 – 36,000 labour) = KES 139,000 to 174,000 per acre.</p>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Pyrethrum enterprise ownership is dominated by men Weeding is mostly done by women and children. Dissemination strategies should target them more but also sensitize men and youths to understand the benefits of mulching. Mulching can reduce labor spent on manual weeding. This could save time for other activities for women and children.
Gender related opportunities	<ul style="list-style-type: none"> Opportunities exist for males and youth males in mulching the crop. Affirmative action opportunities exist for women and youths to acquire the required credit Weeding labour is reduced therefore opportunities exist for women and youth to get in other economic activities including marketing.
VMG issues and concerns in development, dissemination, adoption	<p>VMG groups could have limitations in accessing the knowledge, resources and can be exposed to many threats such as insecurity and land disputes.</p>

and scaling up	
VMG related opportunities	Training for VMG on mulching practices and opportunities that may emerge
E: Case studies/profiles of success stories	
Success stories	Mulching pyrethrum with bean straws/mulches increased yields in Kisii and Nakuru Counties.
Application guidelines for users	
F: Status of TIMP Readiness 1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Email: cd.narl@kalro.org
Lead organization and scientists	KALRO, Kabete Momanyi Violet and Hottensiah Mwangi
Partner organizations	KALRO, relevant NGOs, CBOs, County Governments, KEPHIS

2.11.4 Solarization for Weed Management in Pyrethrum (Management practice)

2.11.4 TIMP name	Solarization for Weed Management in Pyrethrum
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low and poor quality yields of pyrethrum due to competition for growth resources such as nutrients from different annual and perennial weed species combined with poor weed management approaches.
What is it? (TIMP description)	Solarisation is a method where transparent/ clear polythene films/ plastic is used to heat the soil and kill weed seedlings and seeds in the top six inches of the soil. This increases soil temperatures by 10 ⁰ C or more above the atmospheric temperature. The basic phenomenon involves the building up of lethal high temperatures in the soil where most dormant and viable seeds are present.


	 <p><i>Solarization of soil using transparent polythene film.</i> <i>Source: infonet-biovision.org</i></p> <p>The mechanism can increase soil temperature by 8-12°C above the non-mulched soil. Rhizomes of perennial weeds may be killed if not deeply buried. Effectiveness depends on specific species and the heating duration.</p>
Justification	<p>Solarization for two consecutive years is successful in controlling perennial and annual weeds in pyrethrum. The mechanism effectively breaks the dormancy of weed seeds, solar scotches emerged weed seedlings and directly kills the weed seeds by heat. Solarization with 0.05mm polythene sheets for 40 days is effective in controlling weeds than use of 0.01mm polythene and takes shorter time duration. This is a good ecological and environmentally friendly method that is sustainable for small scale organic growers</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension workers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive research to scale solarization technology in pyrethrum cropping systems. • A platform for interaction of pyrethrum value chain stakeholders • Promotion and training on solarization technology. • Promotion with demos and field days for farmer groups and stakeholders on effectiveness of solarization technology using

	<p>FFSB approach.</p> <ul style="list-style-type: none"> • Training of stakeholders on biology, weed dynamics and identification of weeds in the cropping systems. • Farmer training on conservation of biodiversity by preservation of pollinators when using herbicides for increased productivity.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO to conduct further evaluations and advice on Technical issues • County governments and MoALD to provide extension services, farmer mobilization and policy formulation • Relevant CBOs and NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Not known but very successful in the Netherlands.
Counties where TIMP will be promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low/ no use of solarization • Labour intensity while spreading the polythene paper • Limited knowledge and skills on how to use solarization. • Awareness and knowledge on the right polythene to avoid purchasing the wrong one. • Proper disposal of the used polythene to minimize polluting the environment.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Train agricultural extension county officers as TOTs on appropriate use of solarization to help transfer knowledge and skills to the farmers. • A plan for proper disposal of the polythene paper to be put in place to avoid polluting the environment.
Lessons learned	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform. • Creation of awareness through demonstrations and farmer field days help in adoption of Solarisation for weed control • Availability of market is essential • Partnership is important in technology dissemination and adoption.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • This is a good ecological and environmentally friendly method that is sustainable for small scale organic growers • Sensitization of communities on alternative methods of weed control and appropriate use of transparent polythene is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Labour cost for 2 land preparations using a sub-soiler is about KES 30,000 per acre. Cost of polythene and spreading on soil is about KES 10,000. Total cost = KES 40,000.
Estimated returns	Dependent on pyrethrum varieties mulching may increase pyrethrum yield by 30%. Returns will be 130% of 500 - 600 kg per acre from 2nd year onwards = 650 - 780kg per acre Total income is 355 x (650 to 780kg) = KES 227,500 to 273,500 per acre Estimated returns: Income (KES 227,500 to 273,500) - cost (KES 40,000) = KES 187,500 to KES 233,000.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and children are the main sources of labour for this crop. • Adoption of technology will reduce the labour burden on women and children. • The children can get time for school work, while the women can engage in other economic activities.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for males and youth males to spread the transparent paper on the soil. • Affirmative action opportunities exist for women and youths to acquire the required credit • Women stand to benefit in increased production due to timely operations, increased yields and sales.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to prejudice associated with their social status, VMGs are excluded from accessing benefits from improved technologies. Thus, affirmative action is required to promote solarization for the VMGs including value addition aspects. • Timely operations will lead to enhanced production for VMGs.
VMG related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased income for VMGs and thus improved livelihoods.
E: Case studies/profiles of success stories	
Success stories	Solarization successfully controls weeds in the Netherlands
Application guidelines for users	Josiah Marquez and Koon-Hui Wang. Soil Solarization as an Organic Pre-Emergent Weed-Management Tactic. SA-14, Dec. 2014. https://www.ctahr.hawaii.edu/oc/freepubs/pdf/SA-14.pdf
F: Status of TIMP readiness 1. Ready for upscaling: 2. Requires validation; 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Tel:+254-0721822312

	Email: cd.narl@kalro.org
Lead organization and scientists	KALRO, Kabete Momanyi Violet and Hottensiah Mwangi
Partner organizations	KALRO, relevant NGOs, CBOs, County Governments

2.11.5 Hand-weeding in Pyrethrum Production (Management practice)

2.11.5 TIMP Name	Hand-weeding in Pyrethrum Production
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds can drastically reduce flower yields by interfering with tiller development and may kill the pyrethrum crop if not managed by the third month. This is due to infestation by different annual and perennial weed species that compete for growth resources such as nutrients, combined with poor weed management approaches.
What is it? (TIMP description)	<p>Mechanical weed control is a technique that controls weed populations through manual physical methods which remove, injure or kill the weeds. Manual hand weeding is done using tools such as pangas, jembes and slashers.</p>  <p style="text-align: center;"><i>Weed control using hoes</i></p>
Justification	Weeds if not controlled will take over, win the competition and cause yield losses. Young pyrethrum crop is vulnerable to weed invasion. Weeds reduce flower yields by interfering with tiller development and may kill the pyrethrum crop if not managed by the third month. Fields should always be kept weed-free. The growth of weeds can be destroyed by use of manual hand weeding to get a clean crop that will give higher yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Agricultural extension officers. • CBOs and NGOs

Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Promotion and training of extension officers and farmers on the importance of weeding. • Training of farmer groups and stakeholders on importance and effectiveness of weed control. • Training of stakeholders on biology, weed dynamics and identification of weeds in the cropping systems.
Partners/ stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • KALRO to conduct further evaluations and advice on Technical issues • County governments and MoALD to provide extension services, farmer mobilization and policy formulation • Relevant CBOs and NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where already promoted if any	Kisii and Nyamira counties
Counties where TIMP will be scaled up	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • Labour intensity • Reduced effectiveness on weed control if hired labour is not properly supervised
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms innovation platforms to facilitate interaction of farmers with relevant stakeholders • Work with Jua Kali industries/ sector for fabrication of appropriate hand held implements.
Lessons learned	<ul style="list-style-type: none"> • Creation of awareness through demonstrations and farmer field schools help in adoption of the technologies • Access and use of appropriate weeding tools will provide timely weed management with reduced labor to enhance crop production.
Social, environmental, policy and market conditions necessary	This is readily available means of weed control and has minimal environmental impact if it well timed to take place when there in too much rain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Manual weeding is about KES 12,000 per acre (12 casuals per day@ KES 500 for 2 weedings).

	Total cost is about = KES 12,000
Estimated returns	Dependent on pyrethrum varieties planting in a clean weed free seed bed and hand weeding monthly will give an average yield of 500 – 600kg per acre @ 350 = KES 175,000 to KES 210,000. Estimated returns = Income (KES 175,000 to KES 210,000) - Total cost (12,000) = KES 163,000 to KES 198,000.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and children are the main sources of labour. Increased workload of weeding pyrethrum is likely to impact on women and school going children. • Need to also sensitize men on the value of weed losses caused by weeds in order to be involved timely mechanical weed control.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit • Women stand to benefit from increased production and sale of pyrethrum which will improve the household income.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Due to prejudice associated with their social status, VMGs are excluded from accessing and benefiting from improved technologies. Thus, affirmative action is required to promote the management practice to the VMGs. • Timely operations will lead to enhanced production for VMGs.
VMG related opportunities	Increased production will improve sales and economic empowerment of VMGs
Success stories	Proper and timely mechanical weed management has effectively managed weeds in fields
Application guidelines for users	<ol style="list-style-type: none"> 1. Kenya Agricultural and Livestock Research Organization. KARI Molo Annual Report, 2008. 2. Pyrethrum Growers Manual (2019).
F: Status of TIMP Readiness 1. Ready for up-scaling; 2. Requires validation; 3. Requires Research	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Tel:+254-0721822312 Email: cd.narl@kalro.org
Lead organization and scientists	KALRO, Kabete Momanyi Violet and Hottensiah Mwangi
Partner organizations	KALRO, relevant NGOs, CBOs, County Governments

2.11.6 Stale Seed Bed for Weed Management in Pyrethrum (Management practice)




2.11.6 TIMP Name	Stale seed bed for weed management in pyrethrum
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low and poor quality yields of pyrethrum due to a rich dormant seed bank of diverse annual and perennial grass and broad leaved weed species in the soil which germinate and compete with the crop for growth resources such as nutrients, combined with poor weed management approaches.
What is it? (TIMP description)	This is a weed management practice in which weed seeds just below the soil surface germinate after rainfall or wetting the soil. The resultant dense flush young weeds is then killed using post-emergent herbicides such as glyphosate and paraquat 1 - 3 weeks before planting pyrethrum seeds.
Justification	This technology effectively controls broad and narrow leaved weeds that germinate and emerge before the crop is planted. Competition from weeds deprive pyrethrum of available resources for growth leading to weak and stunted growth and may kill the young pyrethrum crop depending on weed density and diversity and stage of weed growth.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	<ul style="list-style-type: none"> • 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, demonstrations on larger plots, training on how to use stale bed.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive research to validate and release stale seed bed for weed management in pyrethrum varieties. • A platform for interaction of pyrethrum value chain stakeholders • Capacity building and training on use of stale seed bed
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • KALRO to conduct further evaluations and advice on technical issues • Agrochemical companies and Agro-dealers to provide recommended herbicides • County governments and MoALD to provide extension services, farmer mobilization and policy formulation • Relevant CBOs and NGOs to provide micro finance services
C: Current situation and future scaling up	
Counties where already promoted if any	Many Counties but on other cropping systems such as vegetables
Counties where TIMP will be promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet,

	Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • Low/ no use of the technology • Labour intensity • Limited knowledge and information and low literacy levels among the farmers. • Limited knowledge and skills on appropriate use of herbicides for stale seed beds.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • There is need to train the agricultural extension county officers as TOTs on appropriate use of stale seed beds. This will help in passing the information to farmers.
Lessons learned	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Awareness creation through demonstrations and farmer field days could help in adoption of the technology of Stale seed bed • Availability of market is essential • Partnership is important in technology dissemination and adoption.
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of stale seed beds in pyrethrum is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Labour cost for one land preparations using a sub-soiler is about KES 15,000 per acre.</p> <p>Cost of pre- or post-emergent herbicide plus labour for spraying is about KES 6,000 per acre.</p> <p>Total cost will be about KES 21,000</p>
Estimated returns	<p>Dependent on pyrethrum varieties stale seed bed increases pyrethrum yield by about 30% per acre.</p> <p>Basic income = 130% of KES 175,000 to 210,000=. KES 227,500 to KES 273,000.</p> <p>Estimated returns = Basic income - Total cost = KES 227,500 to KES 273,000 - KES 21,000 = KES 206,500 to 252,000 per acre.</p>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and children are the main sources of labour for this crop. • Women are involved in spraying yet it is not recommended.
Gender related opportunities	<ul style="list-style-type: none"> • Adoption of technology will reduce the labour burden on women and children. The children can get time for school work, while the women can engage in other economic activities. • Women stand to benefit in increased production due to timely operations thus, increased yields and sales.
VMG issues and concerns	<ul style="list-style-type: none"> • Due to prejudice associated with their social status, VMGs are

in development, dissemination, adoption and scaling up	<p>excluded from accessing benefits from improved technologies. Affirmative action is thus required to promote use of stale seed bed in pyrethrum by VMGs.</p> <ul style="list-style-type: none"> • Timely operations will lead to enhanced production for VMGs.
VMG related opportunities	<ul style="list-style-type: none"> • Increased production will lead increased income for VMGs and hence economic empowerment of VMGs.
E: Case studies/profiles of success stories	
Success stories	Very successful in countries like the Netherlands
Application guidelines for users	<ol style="list-style-type: none"> 1. Weed control leaflets/ manuals. 2. Information and instructions always displayed on the labels attached to container on how to use. 3. Guihua Chen and Cerruti RR Hooks (2021). The Stale Seedbed Technique: A Relatively Underused Alternative Weed Management Tactic for Vegetable Production. https://extension.umd.edu/resource 4. Wanjala, B. W. K. (1989). Weed control methods in pyrethrum production in Kenya, Pp.57. In: Adipala, E. Tusiime, G. and Okori, (eds). Proceedings of the 16th Biennial weed Science Society Conference for Eastern Africa. Kampala, Uganda.
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires Validation 3. Requires further research)	Requires validation
G: Contacts	
Contacts	<p>Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Tel:+254-0721822312 Email: cd.narl@kalro.org</p>
Lead organization and scientists	<p>KALRO, Kabete Momanyi Violet and Hottensiah Mwangi</p>
Partner organizations	KALRO, relevant NGOs, CBOs, County Governments

2.11.7 Crop Rotation for Weed Management in Pyrethrum (Management practice)

2.11.7 TIMP Name	Crop Rotation for Weed Management in Pyrethrum
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low and poor quality yields of pyrethrum due to competition for growth resources such as nutrients from different annual and perennial weed species (some specific to pyrethrum) combined with poor weed management approaches.
What is it? (TIMP description)	Crop rotation is the growing of different crops in succession on a piece of land to avoid exhausting the soil and to control weeds, pests and


	<p>diseases specific to the crop. A good successive weed control strategy should include a crop rotation schedule for optimal pyrethrum production and yield.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>Wild rape seed (<i>Brassica napus</i>, <i>Brassica oleracea</i>, <i>Brassica rapa</i> subsp. <i>sylvestris</i>)</p> </div> <div style="text-align: center;">  <p>Corn marigold (<i>Glebionis segetum</i>)</p> </div> <div style="text-align: center;">  <p>Purslane weed (<i>Portulaca oleracea</i>)</p> </div> </div> <p>Major pyrethrum weeds which are proving difficult to control with current strategies, particularly in young crops include couch grass (<i>Digitaria abbyssinica</i>), sedges (<i>Cyperus rotundus</i>), Wild rape seed (<i>Brassica</i> spp.), Corn marigold- <i>Glebionis segetum</i>), oxalis (<i>Oxalis latifolia</i>) portulaca/ purse lane (<i>Potulaca Oleraceae</i>), cleavers (<i>Galium aparine</i> L.)</p>
Justification	<p>There is need to have a rotation plan for pyrethrum. Land can be divided into a number of distinct areas where the crops will be rotated every 3 to 4 years. This will help to manage and prevent spread and build-up of weeds that are common to the crop.</p> <p>Flower yield declines to an uneconomical level in subsequent years due to accumulated effect of specific weeds that compete for nutrients if pyrethrum is left in the same field for more than three years. Cereals such as maize, wheat, oats barley or grasses such as weeping love grass, guinea grass, guatemala grass may be used for rotation.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on-station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer-to-farmer extension models Mass media – Electronic and print Publications - posters/brochures/leaflets, manuals Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for	<ul style="list-style-type: none"> Applied and adaptive research to upscale and release crop rotation

successful promotion	<p>technology in pyrethrum cropping systems.</p> <ul style="list-style-type: none"> • A platform for interaction of pyrethrum value chain stakeholders • Promotion with demos and field days for farmer groups and stakeholders on effectiveness of rotation as an effective weed management option. • Training of stakeholders on biology, weed dynamics and identification of weeds in pyrethrum.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • KALRO to provide Research services • County governments and MALD to provide extension services, farmer mobilization and policy formulation • Relevant CBOs and NGOs to provide micro financing services
C: Current situation and future scaling up	
Counties where promoted if any	Kisii, Nakuru
Counties where TIMP will be promoted	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Low use of the technology • Small farms due to family subdivisions • Labour intensity
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish pyrethrum innovation platforms to facilitate interaction of farmers with relevant stakeholders • Dissemination of information 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 pyrethrum growing regions.
Lessons learned	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Creation of awareness through demonstrations and farmer field days help in adoption of the technology • Availability of market is essential • Partnership is important in technology dissemination and adoption of this TIMP. • Use of appropriate crop rotation plan will provide timely control of weeds common and difficult to control in pyrethrum.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the crop rotation practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Labour cost for 2 land preparations using a sub-soiler is about KES 30,000 per acre. Manual weeding is reduced to about KES 8,000 per acre (8 casuals per day@ KES 500 for 2 weedings).</p> <p>Total cost is about = 38,000</p>

Estimated returns	<p>Average yield 500 - 600kg per acre @ 350 = KES 175,000 to KES 210,000.</p> <p>Estimated returns: Income (KES 175,000 to KES 210,000) - Total cost (38,000) = KES 137,000 to KES 172,000.</p>
Gender issues and concerns in development, dissemination, adoption and scaling up	Need to sensitize both men and women on value of practicing rotation for timely weed control and reduction of weed seed banks.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for males and youth males in subdividing fields for crop rotation. • Affirmative action opportunities exist for women and youths to acquire the required credit • Women stand to benefit from increased production through sale of extra produce which will improve the household income.
VMG issues and concerns in development, dissemination, adoption and scaling up	Due to prejudice associated with their social status, VMGs are excluded from accessing benefits from improved technologies. Affirmative action is required to promote rotation in pyrethrum for the VMGs including value addition aspects.
VMGs related opportunities	Increased production will improve economic empowerment of VMGs
E: Case studies/profiles of success stories	
Success stories	Kisii and Nakuru Counties
Application guidelines for users	<ol style="list-style-type: none"> 1. Charles L. Mohler and Sue Ellen Johnson (2009). The Role of Crop Rotation in Weed Management. Sustainable Agriculture Research and Education. https://www.sare.org/publications/ 2. Kenya Agricultural and Livestock Research Organization. KARI Molo Annual Report, 2008.
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research)	Ready for upscaling
G: Contacts	
Contacts	<p>KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org</p>
Lead organization and scientists	<p>KALRO Violet Momanyi, Hottensiah Mwangi</p>
Partner organizations	KALRO, MoALD in Counties

2.12 HARVEST AND POSTHARVEST HANDLING

2.12.1 Maturity Indices (Management practice)

2.12.1 TIMP Name	Maturity Indices
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Losses due to harvesting before maturity or delayed harvesting
What is it? (TIMP description)	<p>Maturity indices for pyrethrum flower harvesting are visual and physical features used to determine the ideal time to harvest pyrethrum flowers to ensure maximum pyrethrin content. Harvesting pyrethrum flowers at the proper maturation stage ensures the highest pyrethrin content.</p> <p><i>Maturity indices and correct time for harvesting:</i> The first picking of mature flowers occurs 3 to 4 months after planting and Thereafter, the flowers are picked every 2 weeks. The right stage to pick pyrethrum is when ray florets (the white petals) have opened to horizontal position and 3 to 4 disc florets are open (<i>see image below</i>). This is the time the flowers are in full bloom, and the concentration of pyrethrin is at its peak. During the optimal stage, the pyrethrins content may reach 1.8 to 2.2% in improved clones.</p> <div>  </div> <p><i>Left:</i> A good stand of pyrethrum flowers ready for harvesting. <i>Right:</i> 3 to 4 disc florets open – pyrethrin content at 2.2% w/w. (<i>Source: Lusike Wasilwa</i>)</p>
Justification	Picking pyrethrum flowers at the right stage is critical for pyrethrin content, quality, and profitability. Incorrect timing of harvesting pyrethrum flowers results in pyrethrin losses and low income for the farmer. Harvesting young flowers yields low pyrethrin concentrations, while delaying plucking for over


	two weeks results in overblown flowers with diminished pyrethrin content and hinders new flower initiation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Agripreneurs, extension service providers, processors
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Application of good agronomic practices to have a good crop. It's advisable to consider three or more signs of maturity to be sure the harvest is ready.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on correct maturity indices for pyrethrum • Negative attitude by farmers towards adoption of new agricultural TIMPs • Low uptake before farmers see results
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation/capacity building about the TIMP to farmers and traders • Availing data on the economics and gains that accrue from adopting the TIMP

Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitizations motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the TIMP • Appropriate and favorable policy on adoption of the TIMP • Policies on empowerment of women and youth as entrepreneurs in society • The market to absorb increased harvest arising from farmers' adoption of the correct maturity indices • Data on the economics and gains that accrue from adopting the TIMP
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined. Expected gains include reduced losses and better farmers' income from sale of saved pyrethrum flowers.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The TIMP requires keen observation and knowledge of crop maturity which may be a challenge to both men and women. • The TIMP is easily adoptable after training and many farmers can use it since it reduces losses incurred during and after harvesting. • Women have limited access to education, training and extension services
Gender related opportunities	<ul style="list-style-type: none"> • The TIMP increases farm income through reduction of harvest losses. • Men can capitalize on this aspect of pyrethrum production to reduce harvest losses
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	Adoption of the TIMP means reduced losses, hence more pyrethrum available for utilization and sale.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Women and youth groups in Nakuru County who utilize the appropriate maturity indices have reported improved incomes from adopting the TIMP
Application guideline for users	<ol style="list-style-type: none"> 1. Crop Nutrition Laboratory (CROPNUTS). Undated. Pyrethrum Growing in Kenya: Suitability Factors. www.cropnuts.com 2. Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum

	<p>Propagation. KALRO</p> <p>3. Ngugi, C. W., Ikahu, J. K., and Gathungu, G. K. (2008). Pick Pyrethrum at the Correct Stage. KARI Information Brochure Series 63/2008.</p>
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100 - 20106 MOLO Email: kalro.molo@kalro.org <u>KALRO Call Center: 0111010100</u></p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO</p> <p>Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, formulators and processors

2.12.2 Harvesting Procedure (Innovation)

2.12.2 TIMP Name	Harvesting Procedure
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Reduced productivity due to inappropriate harvesting procedure
What is it? (TIMP description)	The harvesting procedure for pyrethrum flowers is the method of picking mature flowers at the right time to maximize pyrethrin content and quality.


		
<i>Harvesting pyrethrum flowers (Source: Lusike Wasilwa)</i>		
Justification	Inappropriate harvesting procedure limits productivity by resulting in poor quality and lower pyrethrin content in pyrethrum flowers. This includes picking stalks alongside flowers and harvesting under rainy conditions which lead to fermentation and reduced quality and pyrethrin content. Implementing appropriate harvesting procedure has the potential to reduce these losses and, in turn, boost pyrethrum productivity.	
B: Assessment of dissemination and scaling up/out approaches		
Users of TIMP	Farmers, traders , cooperatives, extension service providers	
Approaches used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)• Demonstrations - On-farm and on-station• Agricultural shows/exhibitions/field days• Trainings - workshops/Seminars/Meetings• Public and private Extension Agents• Farmer-to-farmer extension models• Mass media – Electronic and print• Publications - posters/brochures/leaflets, manuals• Digital Platforms– Website, Dashboards, Apps, social media, short message services	
Critical/essential factors for successful promotion	Application of good agronomic practices to have a good pyrethrum crop	
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none">• Farmers and CIGs for activity implementation and promotion• Extension service (public and private) to undertake technology transfer and dissemination• Researchers (for instance from KALRO and universities) to establish demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices• Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop	
C: Current situation and future scaling up		
Counties where already	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia,	

promoted if any	Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on appropriate harvesting technology for pyrethrum • Negative attitude by farmers towards adoption of new agricultural TIMPs
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Continuous capacity building with practical demonstrations • Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CBOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitizations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the TIMP • Appropriate and favorable policy on adoption of the TIMP • The market to absorb increased harvest arising from farmers' adoption of the correct maturity indices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Reduced losses and hence better income (due to appropriate harvesting techniques)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • In the target counties, pyrethrum harvesting is mainly done by women and youth increasing their work burden • Women loss their crops due to late harvesting as a result of being overworked • Women have no finances to pay for hired labor for harvesting due to limited access to credits • The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during and after harvesting.
Gender related opportunities	The TIMP increases farm income through reduction of harvest losses. Men can capitalize on this aspect of pyrethrum production to reduce harvest losses
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • It is labor intensive for some VMGs especially the PLWD and the sick. • VMGs lack access to information on new technologies and information • VMGs have no finances due to limited access to credit facilities • Mechanical harvesting can be encouraged to all gender, including the VMGs.
VMG related opportunities	<ul style="list-style-type: none"> • Adoption of the TIMP means reduced harvest losses • This will enable VMGs to have enough pyrethrum flowers to sell • Adherence to recommended harvesting procedures offers opportunities for lucrative commercial venture, hence more income for VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar	Women and youth groups in Nakuru County who utilize appropriate harvesting practices have reported improved incomes from adopting the TIMP

projects	
Application guideline for users	<ol style="list-style-type: none"> 1. Crop Nutrition Laboratory (CROPNUTS). Undated. Pyrethrum Growing in Kenya: Suitability Factors. www.cropnuts.com 2. Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO. 3. Ngugi, C. W., Ikahu, J. K., and Gathungu, G. K. (2008). Pick Pyrethrum at the Correct Stage. KARI Information Brochure Series 63/2008
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO</p> <p>Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.12.3 Harvesting Basket (Technology)

2.12.3 TIMP Name	Harvesting Basket
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Losses due to fermentation caused by use of gunny bags in collecting picked pyrethrum flowers
What is it? (TIMP description)	This is a basket for collecting harvested pyrethrum flowers. It has good ventilation and aeration to prevent fermentation of picked flowers.

	 <p><i>Pyrethrum harvesting basket (Source: Robert Lagat, KALRO Molo)</i></p>
Justification	Well-ventilated harvesting containers prevent fermentation of pyrethrum flowers. One such container is the harvesting basket. Harvesting flowers in this basket helps prevent flower fermentation and results in higher quality flowers with higher pyrethrin content. Polyethylene bags and tins should be avoided since they contribute to fermentation, which the "harvesting basket" successfully controls by its good ventilation and aeration.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders , cooperatives, extension service providers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Application of good agronomic practices to have a good pyrethrum crop. • Creating awareness on effects of inappropriate harvesting containers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs – for activity implementation and promotion • Extension service (public and private) – technology transfer and dissemination • Researchers (KALRO, universities) – establishment of demonstration plots, capacity building of county stakeholders, extension workers and farmers on pyrethrum harvesting procedures and containers • Processing companies e.g. Pyrethrum Processing Company of Kenya (PPCK), etc. – capacity building of farmers on the quality of pyrethrum they purchase; provide market for quality pyrethrum hence spur growth of the crop



C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on pyrethrum harvesting containers • Negative attitude by farmers towards adoption of new agricultural TIMPs
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Continuous capacity building with practical demonstrations • Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the TIMP • Availability of entrepreneurs to make the baskets for sell to farmers • Appropriate and favorable policy on adoption of the TIMP • The market to absorb increased harvest arising from farmers' adoption of the correct maturity indices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately KES 500 per unit. The basket can be used for at least 3 years
Estimated returns	Reduced losses and hence better income (due to appropriate harvesting techniques)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • In the target counties, pyrethrum harvesting is mainly done by women and youth increasing their work burden • Women lose their crops due to lack of appropriate harvesting bag • The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred during and after harvesting.
Gender related opportunities	<ul style="list-style-type: none"> • The TIMP increases farm income through reduction of harvest losses. • Men can capitalize on this aspect of pyrethrum production to reduce harvest losses
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	Adoption of the TIMP means reduced losses, hence more pyrethrum available for sale.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guideline	Lagat, R. (2023). Pyrethrum Harvesting Baskets for Better Quality Pyrethrum.

for users	KALRO Factsheet.
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

Gaps:

- Socioeconomic acceptability of the harvesting basket to farmers

2.12.4 Improved sun-drying of pyrethrum (Management practice)

2.12.4 TIMP Name	Improved sun-drying of pyrethrum	
	<div></div> <p><i>Sun-drying of pyrethrum on mats</i></p>	
Category (i.e. technology, innovation or management practice)	Management practice	
A: Description of the technology, innovation or management practice		
Problem to be addressed	Improper sun-drying of pyrethrum flowers leading to degeneration of pyrethrin content as result using inappropriate drying material.	
What is it? (TIMP description)	Drying management practice which ensures effective drying of pyrethrum flowers in an appropriate manner maintaining the quality and quantities under open direct sunlight.	


Justification	<p>Majority of pyrethrum farmers in Kenya use open sun-drying methods to dry freshly harvested pyrethrum flowers. This is coupled with use of assorted unstandardized drying materials that contribute to losses in quantities of the flowers and quality of the pyrethrin.</p> <p>The drying materials range from stitched old gunny bags, construction polythene sheets, stitched cement bags etc. KALRO, OneAcre fund and KEBs have partnered to produce a new standard for agricultural tarpaulins which needs to be adopted by pyrethrum growers.</p> <p>Use of standard agricultural tarpaulins will ensure quick uniform drying reducing on flower fermentation and moulding which leads to loss of pyrethrin content. With standardized tarpaulin, the flowers dry in 2-3 days under favorable weather conditions but takes 6-8 days during cloudy conditions.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, Extension staff, agripreneurs, County governments and partners
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Cost of the recommended standard agricultural tarpaulin • Awareness creation to provide knowledge to the farmers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Private sector – to provide business investment on the TIMP • KALRO – training, demonstration and TIMP backstopping • Pyrethrum Processing Company of Kenya – awareness and training • Farmers – up-scaling the TIMP • Cooperative societies – mobilization and training • Extension staff - Training
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> • All the pyrethrum growing counties in Kenya such as Nakuru, Nyandarua, Bomet and Kakaemga
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on sun-drying of pyrethrum and use of tarpaulins • Access to sufficient technical capacity for training to increase adoption • Negative attitude by farmers towards adoption of new agricultural

	TIMPs
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • KALRO to design, develop and promote the technology • Engaging the private sector on business models so as to invest on technology • Collaborate with agro-dealers across the pyrethrum growing counties to promote the technology • Continuous capacity building with practical demonstrations • Link farmers to microfinance institutions to acquire the tarpaulins • Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • TIMP has the ability to reduce losses and hence generate more incomes to the farmer
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers willingness to adopt the TIMP • Favorable environment for adoption of the TIMP • Favorable weather conditions for drying • Favourable policies encouraging purchase of the standard tarps • Cost of the TIMP • Market availability
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Tarpaulin costs KES 3,000 (2 x 6' tarpaulin)
Estimated returns	Maintained quality of pyrethrin content as there is efficient drying (no fermentation), reduced postharvest losses, increased household income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The implementation will reduce their work burden of the various gender categories who perform the task of drying therefore allowing them time to engage in other economic activities. • Women and youth have limited access credit to purchase the implement. • Women and youth have limited access to education, training and extension services . • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities such as the women and youth enterprise fund exist for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities such as the women and youth enterprise fund exist for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • The standard tarpaulins have the potential to scale due to inherent benefits

Application guideline for users	<ol style="list-style-type: none"> 1. Use of TIMP fact sheet 2. Wanja, N., Busienei, T. P. and Peter, E. P. (2008). Use Pyrethrum Solar Dryers for Increased Income. KARI Information Brochure Series 75/2008. 3. Crop Nutrition Laboratory (CROPNUTS). Undated. Pyrethrum Growing in Kenya: Suitability Factors. www.cropnuts.com 4. Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO.
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA. Email: director.amri@kalro.org</p>
Lead organization and scientists	KALRO Patrick Ketiem, Wayua F.O., Ndambuki, Janet Obanyi, Eliud Kizito, Lagat Robert, Irene Murithi Lusike Wasilwa and Violet Kirigua
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.12.5 Drying of pyrethrum flowers on raised pyrethrum wire mesh tray with open roof (Innovation)

2.12.5 TIMP Name	Drying of pyrethrum flowers on raised pyrethrum wire mesh tray with open roof
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest losses due to fermentation of pyrethrum flowers as a result of inefficient drying.
What is it? (TIMP description)	This is drying pyrethrum flowers in the tray dryers before storage or delivery to the factory. The flowers dry in 1 to 2 days under favorable weather conditions but takes 5 to 7 days during cloudy conditions.


	 <p><i>Drying of pyrethrum on raised wire mesh tray</i> (Source: Lusike Wasilwa)</p>
Justification	Inappropriate flower drying causes fermentation and pyrethrin loss, resulting in lower quality and inefficient milling at the factory. Sun drying is cost-effective for small-scale production, with minimal pyrethrin loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and farmer groups, agribusiness entrepreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Training - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Adequate distribution of the tray dryers to farmers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • Private sector –for supplying the dryers (dehytray) • County governments –Help in the dissemination of the technology • Research and Academia – Capacity building on solar drying of pyrethrum flowers • Financial institutions – provide funds for acquiring the tarpaulins • Pyrethrum Processing Company (PPCK), for capacity building on dryers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet,

will be up scaled	Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on tray dryers of pyrethrum • Access to sufficient technical capacity for training to increase adoption • Negative attitude by farmers towards adoption of new agricultural TIMPs
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Continuous capacity building with practical demonstrations • Link farmers to microfinance institutions to acquire the tray dryers • Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	Continuous capacity building and availing the tray dryers closer to farmers is key to adoption
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers will be willing to adopt the TIMP • There will be entrepreneurs to stock the tray dryers closer to farmers and sell to farmers • There will be favourable policy for adoption of the TIMP • The market will be able to absorb increased supply of pyrethrum flowers from reduced harvesting losses and better quality as results of adoption of the TIMP
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Commercial dryer is 160,000 KES
Estimated returns	Increased quality of pyrethrum as there is efficient drying (no fermentation), reduced postharvest losses, increased household income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth may not be able to mobilise resources needed to acquire the dryers • Women have limited access to education, training and extension services • Men dominant most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women and youth in fabrication, sale and repair of the dryers
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunity for VMGs to engage in fabrication of dryers • Opportunity to produce and trade in locally produced pyrethrum based products
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Women and youth groups in Nakuru County who utilize appropriate sun-drying practices have reported improved incomes from adopting the TIMP
Application guideline for users	<ol style="list-style-type: none"> 1. Wanja, N., Busienei, T. P. and Peter, E. P. (2008). Use Pyrethrum Solar Dryers for Increased Income. KARI Information Brochure Series 75/2008. 2. Crop Nutrition Laboratory (CROPNUTS). Undated. Pyrethrum Growing

	in Kenya: Suitability Factors. www.croplinks.com 3. Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO.
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director, KALRO Molo P.O Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100 2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org
Lead organization and scientists	KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.12.6 Drying of pyrethrum flowers on solar dryers (Innovation)

2.12.6 TIMP Name	Drying of pyrethrum flowers on solar dryers
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest losses due to fermentation of pyrethrum flowers as a result of inefficient drying.
What is it? (TIMP description)	This is the process of drying picked pyrethrum flowers using sun-powered equipment (solar dryer). Pyrethrum flowers are dried in the solar dryer before storage or delivery to the factory. The flowers dry in 1 to 2 days under favorable weather conditions but takes 6 to 7 days during cloudy conditions. Picked flowers should be dried at the farm level immediately to avoid loss of quality. Flowers are dried to a moisture content of <13%.

	 <p>KALRO improved solar dryer recommended for pyrethrum flowers <i>(Source: Lusike Wasilwa and Janet Obanyi)</i></p>
Justification	<p>Inappropriate drying of pyrethrum flowers results in fermentation, pyrethrin loss, poor quality, and ineffective milling. Advantages of using a sun dryer include faster drying, clean and dry flowers, less flower loss, less fermentation, greater flowers quality with higher pyrethrin content, and greater income. Furthermore, it is a cost-effective solution because construction materials are easily available, and it is simple to build, making it a viable option for enhancing the drying process for pyrethrum flowers.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and farmer groups, agribusiness entrepreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Adequate distribution of the dryers to farmers • Capacity building on fabrication, operations and maintenance
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • NGOs e.g. Agricultural Technology Development Centres (ATDC) -: fabrication of dryers, technology dissemination through on-farm demonstrations; capacity building of farmers • Private sector – for supplying the dryers • Jua kali artisans – fabrication of the dryers • County governments –Help in the dissemination of the technology • Financial institutions – provide funds for acquiring the dryers
C: Current situation and future scaling up	

Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> Initial acquisition price of the dryers may be unaffordable to small-scale farmers Access to sufficient technical capacity for training to increase adoption
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Link farmers to microfinance institutions to acquire the dryers, or credit to fabricate the solar dryers Sensitise county governments to support farmers Adopting public-private-partnerships (PPP), so that the private sector (e.g. NGOs) can avail the dryers closer to farmers; Capacity building on solar drying of pyrethrum flowers.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> Continuous capacity building and availing the dryers closer to farmers is key to adoption. Adoption of pyrethrum solar dryers will be profitable if private suppliers and cooperatives buy the dryers and provide services to individual or group farmers on a rental basis; or the dryers are acquired by farmers groups
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Farmers' willingness to adopt the TIMP Entrepreneurs to fabricate the solar dryers closer to farmers and sell to them Appropriate and favorable policy on adoption of the TIMP The market to absorb increased supply of dried pyrethrum flowers from reduced harvesting losses and better quality as results of adoption of the TIMP
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	A single dryer unit costs approximately KES 15,000. The structure has a lifespan of up to 5 years with a seasonal replacement of the polythene cover every 6 months at a cost of KES 300
Estimated returns	Increased quality of pyrethrum as there is efficient drying (no fermentation), reduced postharvest losses, increased household income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women and youth may not be able to mobilise resources needed to acquire the dryers Women have limited access to education, training and extension services Men dominant most decisions at the household and community levels
Gender related opportunities	Employment opportunities exist for women and youth in fabrication, sale and repair of the dryers
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to training and extension services Due to their social status VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due to lack of awareness

VMG related opportunities	<ul style="list-style-type: none"> • Opportunity for VMGs to engage in fabrication of dryers • Opportunity to produce, trade in, and consume locally produced pyrethrum based products
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Women and youth groups in Nakuru County who utilize appropriate solar dryers have reported improved incomes from adopting the TIMP
Application guideline for users	<ol style="list-style-type: none"> 1. Wanja, N., Busienei, T. P. and Peter, E. P. (2008). Use Pyrethrum Solar Dryers for Increased Income. KARI Information Brochure Series 75/2008. 2. Wanja, N., Busienei, T. P. and Peter, E. P. (2008). Use Mat Solar Dryer to Dry Pyrethrum. KARI Information Brochure Series 74/2008. 3. Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO.
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.12.7 Combustion drying of pyrethrum flowers (Innovation)




2.12.7 TIMP Name	Combustion drying of pyrethrum flowers
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest losses due to fermentation of pyrethrum flowers as a result of inefficient drying.
What is it? (TIMP description)	This is the drying of pyrethrum flowers by use of hot air produced by use of biogas or electricity. The flowers dry within a day. Picked flowers should be

	dried at the farm level immediately to avoid loss of quality. Flowers are dried to a moisture content of <13%.
Justification	Inappropriate drying of flowers leads to fermentation and loss of pyrethrins, hence reduced quality. The flowers will also not mill efficiently during processing at the factory. Combustion drying is fast and ends with clean dry flowers, reduces loss of flowers, reduced fermentation and better flower quality, high pyrethrins content hence better pay, reduces splashing and scattering by domestic animals, and is affordable since construction materials are available and easy to construct.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and farmer groups, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Adequate distribution of the dryers to farmers • Capacity building on fabrication, operations and maintenance
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • NGOs e.g. Agricultural Technology Development Centres (ATDC) - fabrication of dryers, technology dissemination through on-farm demonstrations; capacity building of farmers • Private sector – for supplying the dryers • Jua kali artisans – fabrication of the dryers • County governments – Help in the dissemination of the technology • Financial institutions – provide funds for acquiring the dryers
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Initial acquisition price of the dryers may be unaffordable to small-scale farmers • Access to sufficient technical capacity for training to increase adoption
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Link farmers to microfinance institutions to acquire the dryers, or credit to fabricate the solar dryers

	<ul style="list-style-type: none"> • Sensitize county governments to support farmers • Adopt public-private-partnerships (PPP), so that the private sector (e.g. NGOs) can avail the dryers closer to farmers; • Capacity build farmers on combustion drying of pyrethrum flowers.
Lessons learned in up scaling if any	<p>Continuous capacity building and availing the dryers closer to farmers is key to adoption.</p> <p>Adoption of pyrethrum combustion dryers will be profitable if private suppliers and cooperatives buy the dryers and provide services to individual or group farmers on a rental basis; or the dryers are acquired by farmers groups</p>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the TIMP • Availability of entrepreneurs to fabricate the combustion dryers closer to farmers and sell to them • Appropriate and favorable policy for adoption of the TIMP • The market to absorb increased supply of dried pyrethrum flowers from reduced harvesting losses and better quality as results of adoption of the TIMP
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Increased quality of pyrethrum as there is efficient drying (no fermentation), reduced postharvest losses, increased household income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the combustion dryers • Women have limited mobility to adopt combustion dryers due to limited mobility and exposure • Processing is mainly done by women, who have limited access and control of resources such as finances to acquire the combustion dryers
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth in fabrication and sale of combustion dryers • There is increased employment opportunities for women and youth for sale of combustion dryers pyrethrum flowers to processing factories
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs lacks access to information on new technologies and information • VMGs have limited access to productive resources such as credit facilities and pyrethrum value addition equipment
VMG related opportunities	The technology can improve food and nutrition security and is a window for increased income.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Women and youth groups in Nakuru County who utilize appropriate solar dryers have reported improved incomes from adopting the TIMP
Application guideline for users	<ol style="list-style-type: none"> 1. Wanja, N., Busienei, T. P. and Peter, E. P. (2008). Use Pyrethrum Solar Dryers for Increased Income. KARI Information Brochure Series 75/2008. 2. Wanja, N., Busienei, T. P. and Peter, E. P. (2008). Use Mat Solar Dryer to Dry Pyrethrum. KARI Information Brochure Series 74/2008. 3. Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G.,

	Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO.
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director, KALRO Molo P.O Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100 2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org
Lead organization and scientists	KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.12.8 Biodegradable Pyrethrum Storage Bags (Technology)

2.12.8 TIMP Name	Biodegradable Pyrethrum Storage Bags
	   <p><i>Sisal bags -Example of a recommended packaging for pyrethrum dry flowers (Source: Janet Obanyi – KALRO Molo)</i></p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest losses of dried flowers resulting from inappropriate packaging containers often made of gunny bags which cause damage by crushing on the flowers, molds and stickiness due to fermentation.
What is it? (TIMP description)	These are biodegradable bags with a carrying capacity of 50kgs to be used for safe storage of dried pyrethrum flowers and during transportation to warehouses and stores. The bags material can be sisal, papyrus etc, which

	slightly expensive to purchase initially but durable since it is reusable, degradable hence environmentally friendly.
Justification	Pyrethrum dried flowers are usually packaged in various forms mostly in gunny bags which are not suitable nor biodegradable leading to environmental pollution. The practice contributes to loss of flowers due to breakages and spillage during transportation, molding and fermentation due to poor aeration this leads to low weights and decreased pyrethrin content leading to low incomes. Packaging of dried flowers should be done gently to avoid the breaking of flowers during transit.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, Extension staff, agripreneurs, County governments and partners
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Market price of the innovative bags and preference to the product • Level of awareness creation to empower farmers/stakeholders with knowledge • Strong partnerships and linkages to many actors in the field • Presence of a functional supply chain of the sisal bags in the target areas (e.g. stocking in local agro-input outlets) • Capacity building on use of the sisal bags for storage of dry pyrethrum flowers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO – training, demonstration and TIMP backstopping • Pyrethrum Processing Company of Kenya – awareness and training • Farmers – up-scaling the TIMP • Cooperative societies –mobilization and training • Extension service providers (Public and private) to help in the dissemination • Agro-input dealers – to supply sisal bags to pyrethrum farmers and other value chain actors • County governments to help in the dissemination of the technology • Financial institutions to provide funds for acquiring the sisal bags
C: Current situation and future scaling up	
Counties where already	Nakuru

promoted if any	
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> All the pyrethrum growing counties in Kenya such as Nakuru, Nyandarua, Bomet and Kakaemga
Challenges in dissemination	<ul style="list-style-type: none"> Availability of the bags
Suggestions for addressing the challenges	<ul style="list-style-type: none"> KALRO to design and develop the innovative bags Engaging the private sector on business models so as to invest on technology Collaborate with agro-dealers across the pyrethrum growing counties
Lessons learned in upscaling if any	<ul style="list-style-type: none"> None
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Positive impact to all genders Environmentally friendly as it is biodegradable Favorable environment for adoption of the TIMP Favorable policies boosting promotion and investment Availability of market
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately KES 100 per sisal bag and has a lifespan of up to 2 years.
Estimated returns	Increased quality of pyrethrum as there is efficient drying (no fermentation), reduced postharvest losses, increased household income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women have less access to agricultural information, technology and knowledge . Women and youth have limited access to education, training and extension services .
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities for youth males and men in packing and storing the produce
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to agricultural information, technology and knowledge . VMGs have limited access to education, training and extension services . Due to their social status VMGs are often excluded from decision making in development and dissemination of the product There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for youth males in packing and storing the produce
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Similar technology for other value chains is highly scalable
Application guidelines for users	<ol style="list-style-type: none"> Use of TIMP fact sheet Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO.
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires	Requires validation

further research)	
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA. Email: director.amri@kalro.org</p>
Lead organization and scientists	<p>KALRO Patrick Ketiem, Wayua F.O., Ndambuki Janet Obanyi, Eliud Kizito, Lagat Robert, Irene Murithi, Lusike Wasilwa and Violet Kirigua</p>
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.12.9 Pyrethrum Stores (Technology)

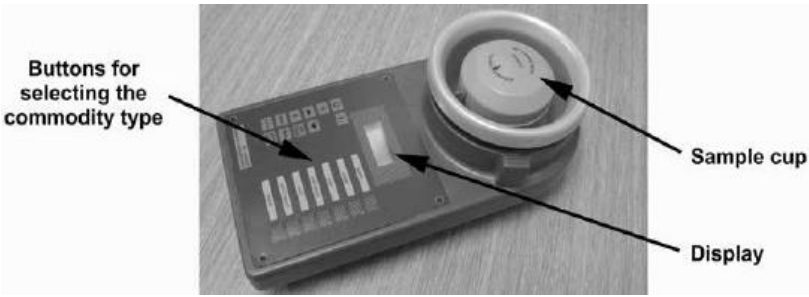
2.12.9 TIMP name	Pyrethrum Stores
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest storage losses of bagged pyrethrum flowers due to inappropriate storage
What is it? (TIMP description)	They are facilities/structures for storing dried pyrethrum flowers and ensure bags are not attacked by rodents. The bags should be stored for a maximum of 10 months and sent to the processing factory. Practice First-In-First-Out (FIFO) principle in stock management.
Justification	Traditionally, dried pyrethrum flowers are stored in sacks or in mud plastered walls and floors. Losses occur due to attack by rodents and excessive moisture that leads to mold growth that reduces quality and is also a health risk. Pyrethrum stores reduce losses by maintaining the quality of stored flowers, and enable farmers to bulk pyrethrum flowers during harvest season and sell the dried flowers during the off seasons at higher prices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Agripreneurs, industrial and commercial processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models

	<ul style="list-style-type: none"> • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Have potential to reduce postharvest losses, increase food security and increase income generation but require functional institutional arrangements, strong management, and external injection of resources to kick-off the process; market linkages and group dynamics are key drivers. • Existence of effective extension services to demonstrate the technology • Dried flowers to be stored must be in good condition for storage (<13% moisture content) • Favourable policy, encouraging better prices for high quality flowers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • NGOs / CBOs • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information • Lack of skills • Lack of credit to construct stores
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Capacity building of farmers, traders and extension agents • Provide appropriate financial services and credit facilities to small-scale farmers and traders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Partnership is important in technology dissemination • Extension training and regular monitoring are essential
Social, environmental, policy and market conditions necessary for development and up scaling	Market's ability to absorb increased supply of quality pyrethrum flowers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of constructing the stores
Estimated returns	Reduced losses, better quality and increased income and nutrition
Gender issues and concerns in development, dissemination	<ul style="list-style-type: none"> • The TIMP is easily adoptable after training and many farmers can use the TIMP since it reduces losses incurred during storage. • Women have limited access to education, training and extension services.

adoption and scaling up	
Gender related opportunities	Opportunities for youth in setting and operating pyrethrum stores
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	Adoption of the TIMP means reduced losses, hence more pyrethrum available for utilization and sale.
E: Case studies/profiles of success stories	
Success stories	Major pyrethrum growing areas in Kenya
Application guidelines for users	Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiemi P., Wambua J., Kirigua V.O. and Wasilwa L. A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.12.10 Pyrethrum Moisture Meter (Technology)

2.12.10 TIMP name	Pyrethrum Moisture Meter
Category (i.e. technology, innovation or management practice)	Technology

A: Description of the technology, innovation or management practice	
Problem addressed	Inefficiency in subjective methods of checking if the pyrethrum has reached the correct moisture content for safe storage (i.e. 13%).
What is it? (TIMP description)	<p>This is an electronic meter for quick and accurate measuring of pyrethrum flower moisture content.</p> 
Justification	Moisture meter enable accurate determination of the recommended moisture content for safe storage of pyrethrum flowers (13%).
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Agripreneurs, industrial and commercial processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Have potential to reduce postharvest losses, increase food security and increase income generation but require functional institutional arrangements, strong management, and external injection of resources to kick-off the process; market linkages and group dynamics are key drivers. • Existence of effective extension services to demonstrate the technology • Dried flowers to be stored must be in right moisture content for storage (<13% moisture content) • Favourable policy, encouraging better prices for high quality flowers
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • NGOs / CBOs • National and County governments • Financial institutions
C: Current situation and future scaling up	
Counties where	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans

already promoted, if any	Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be upscaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of information • Lack of skills • Lack of credit to purchase moisture meters
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Capacity building of farmers, traders and extension agents • Provide appropriate financial services and credit facilities to small-scale farmers and traders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Partnership is important in technology dissemination • Extension training and regular monitoring are essential
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to adopt the technology • Market being able to absorb increased supply of quality pyrethrum flowers with the right moisture content
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Pyrethrum moisture meter cost = KES 60,000
Estimated returns	Reduced losses, better quality and increased income and nutrition
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • The TIMP is easily adoptable after training and many farmers can use it since it reduces losses incurred during storage. • Women have limited access to education, training and extension services
Gender related opportunities	Opportunities for youth in calibrating and selling of the pyrethrum moisture meter
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG related opportunities	Adoption of the TIMP means reduced losses, hence more pyrethrum available for utilization and sale.
E: Case studies/profiles of success stories	
Success stories	Major pyrethrum growing areas in Kenya
Application guidelines for users	Kamau J.K, Kiiya, W., Ajanga, S., Wanyonyi, N., Gathungu, G., Mahasi, M., Mwangi, J. and Pertet, E. (2019). Pyrethrum Propagation. KALRO
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-	Ready for upscaling

requires further research)	
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiemi P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13 VALUE ADDITION

2.13.1 Burning of pyrethrum flowers on Jikos to produce repellent smoke (Innovation)

2.13.1 TIMP Name	Burning of pyrethrum flowers on Jikos to produce repellent smoke
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of pyrethrum at household level
What is it? (TIMP description)	This TIMP involves burning pyrethrum flowers on a 'Jiko' to produce smoke that repels mosquitoes.
Justification	An increase in the use of pyrethrum products results in an increase in production. Pyrethrum has an advantage over other industrial crops because of its natural insect repellent effect, quick 'knockdown' action, and non-persistence in the environment. When pyrethrum flowers are burned, they emit a repellent smoke that drives away insects.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agents, traders
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP)

	<ul style="list-style-type: none"> • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by households/farmers towards adoption of new TIMPs • Low uptake by households/farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation/capacity building about the TIMP to farmers and traders • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitizations would motivate farmers to adopt the TIMP

Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced insects infestation
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services. • Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	Youth and VMGs will need practical observation over time to learn the skill since it is technical.
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2. VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported reduction of mosquitos and insects at their homes
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1- ready for upscaling; 2-requires	Ready for upscaling

validation; 3-requires further research)	
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13.2 Pyrethrum Broom (Innovation)

2.13.2 TIMP Name	Pyrethrum Broom
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited utilization of pyrethrum at household level
What is it? (TIMP description)	Pyrethrum plant is used as a broom to sweep in homes. Due to the chemical they contain called pyrethrins, sweeping with pyrethrum branches enables them to be used as a repellent for the ants. Pyrethrins are commonly used to control mosquitoes, fleas, flies, moths, ants, and many other pests.
Justification	Utilization of pyrethrum as a broom increases utilization of the pyrethrum. The pyrethrum flowers which are used for sweeping contain pyrethrin which kills the ants. Pyrethrins excite the nervous system of ants that touch or eat it. This quickly leads to paralysis and ultimately their death.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS)

dissemination	<ul style="list-style-type: none"> • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by households/farmers towards adoption of new TIMPs
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation / capacity building about the TIMP to farmers • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP

Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduction of ants at household level
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services. • Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2. VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported reduction of ants at their home
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires	Ready for upscaling

further research)	
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13.3 Crop protection product (sprays) (Technology)

2.13.3 TIMP Name	Crop protection product (sprays)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value-added products from pyrethrum in the market
What is it? (TIMP description)	Pyrethrum pyrethrin is used to make crop sprays. The active ingredients from the pyrethrum plants, are commercially available in most places under different commercial names such as "Flower-DS®". They are broad-spectrum insect nerve poisons approved for controlling pests on flowers, fruits and vegetables in the garden and greenhouse. They include dudu spray


	 <p>Dudu spray (<i>Source: AFA</i>)</p>
Justification	<p>Diversification of value added products from pyrethrum increases production and utilization. Pyrethroids target the central nervous system in both target and non-target organisms. Their main mechanism of action is interacting with voltage-gated sodium channels in neurons. This interaction results in depolarization caused by the prolonged influx of sodium ions during excitation. This leads to the death of the insects.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agents
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county

	<p>stakeholders, extension workers and farmers on pyrethrum maturity indices</p> <ul style="list-style-type: none"> Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> Lack of knowledge on correct maturity indices for pyrethrum Negative attitude by households/farmers towards adoption of new TIMPs Low uptake before farmers see results
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Awareness creation/capacity building about the TIMP to farmers and traders Availing data on the economics and gains that accrue from adopting the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption Continuous capacity building is key to attitude change. Consistent trainings, demonstrations and sensitizations motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Appropriate and favorable policy on adoption of the TIMP Households/Farmers will be willing to adopt the TIMP There will be favorable policy for adoption of the TIMP Environmental conditions will be favorable The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> The technology may not be adopted if women are already overwhelmed with other chores Women have limited access to education, training and

	<p>extension services</p> <ul style="list-style-type: none"> Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> VMGs have less access to information, technology and knowledge VMGs have limited access to training Due to their social status, VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> women and girls to earn a living VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported reduction of pests in their farm
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiemi P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>

Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors
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2.13.4 Livestock sprays/Acaricides (Technology)

2.13.4 TIMP Name	Livestock sprays/Acaricides
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value added products from pyrethrum in the market
What is it? (TIMP description)	<p>Pyrethrum is used to make livestock sprays. The active ingredients from the pyrethrum plants, are commercially available. They are widely used in manufacturing livestock sprays which are used to control parasites in livestock. Some of the livestock sprays/acaricides include; pyrethrum grease, and pytix 4 EC</p>  <p>Pyrethrum grease (<i>Source: AFA</i>)</p>
Justification	Diversification of value added products from pyrethrum increases production and wide range of livestock sprays. Their main mechanism of action is interacting with voltage-gated sodium channels in neurons. This interaction results in depolarization caused by the prolonged influx of sodium ions during excitation. This leads to the death of the parasites. They are used to control ticks and flies.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Linkages with private sector to improve production capacity and • empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by farmers towards adoption of new TIMPs • Inadequate extension agents familiar with local dialects of target areas • Availability of extension agents to train households/farmers • Availability of labour required for use in implementation
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation / capacity building about the TIMP to farmers and traders • Availing data on the economics and the gains to be made

	through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Consequently the technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services • Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2. VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported reduction of pests in their farm

Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1- ready for upscaling; 2- requires validation; 3- requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiemi P., Wambua J., Kirigua V.O. and Wasilwa L. A</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13.5 Insecticides (mosquito killer sticks) (Technology)


2.13.5 TIMP Name	Insecticides (mosquito killer sticks)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value added products from pyrethrum in the market
What is it? (TIMP description)	Insecticides are chemicals used to control insects by killing them or preventing them from engaging in undesirable or destructive behaviors. Some of the insecticides from pyrethrum include mosquito sticks.

	  <p>Mosquito killer sticks (<i>Source: Kapi Limited</i>)</p>
Justification	<p>Mosquito Sticks are ideal for use in the home, as the active insecticide is natural pyrethrum. Super effective as well as natural. They may also be used outdoors and will kill a wide range of insects including mosquitoes and flies. These sticks produce smoke which turns away the mosquitoes and flies.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension providers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence

	spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by farmers towards adoption of new TIMPs • Inadequate extension agents familiar with local dialects of target areas • Availability of extension agents to train households/farmers • Availability of labour required for use in implementation
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation / capacity building about the TIMP to farmers and traders • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services • Men dominate most decisions at the household and

	community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2. VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported reduction of mosquitoes and flies in their homes
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1- ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13.6 Storage dusts for food stores and warehouses (Technology)

2.13.6 TIMP Name	Storage dusts for food stores and warehouses
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value added products from pyrethrum in the market
What is it? (TIMP description)	<p>Storage dusts are insecticides used to control insects in the food stores and warehouses. Insecticides are chemicals used to control insects by killing them or preventing them from engaging in undesirable or destructive behaviors. One of the product is pydust which is a yellow/brown powder. It is a contact, broad spectrum insecticide for storage pests.</p>  <p>Pyrethrum-based grain admixture (<i>Source: AFA</i>)</p>
Justification	Diversification of value added products from pyrethrum increases production and wide range of storage and warehouse insecticides. This dust controls insects in the food stores and warehouses such as weevils and grain borers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension providers, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models

	<ul style="list-style-type: none"> • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by households/farmers towards adoption of new TIMPs • Low uptake before farmers see results
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation / capacity building about the TIMP to farmers and traders • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP

	<ul style="list-style-type: none"> • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services • Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2. VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported reduction of storage insects in food stores and warehouses
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	1) The Centre Director, KALRO Molo

	<p>P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	<p>Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors</p>

2.13.7 Lotions, Shampoos and Gels (Technology)


2.13.7 TIMP Name	Lotions, shampoos and gels
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value added products from pyrethrum in the market
What is it? (TIMP description)	<p>A lotion is a topical preparation, applied to the skin with bare hands with the intent to moisturize the skin. While most body lotions primarily aim to keep the skin soft, smooth, and healthy, they can also possess anti-aging properties and include fragrances.</p> 

	<p>Lotion made from pyrethrum (<i>Source: Indiamart</i>)</p> <p>Shampoo is typically in the form of a viscous liquid with some exception of waterless solid form such as a bar. Shampoo cleanses scalp and hair by removing unwanted sebum, dandruff, environmental dust, and residues of hair care products.</p> <p>Gel made of pyrethrum is used as medicine to treat head, body, and pubic lice infections.</p>
Justification	Diversification of value added products from pyrethrum increases production and wide range of storage and warehouse dusts. Pyrethrin and piperonyl butoxide comes as a shampoo, lotion and gel to apply to the skin and hair. It is usually applied to the skin and hair in two or three treatments. The second treatment must be applied 7-10 days after the first one. Sometimes a third treatment may be necessary, as recommended by your doctor. Use pyrethrin and piperonyl butoxide shampoo, lotion and gel exactly as directed.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension providers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices

	<ul style="list-style-type: none"> Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> Lack of knowledge on value added products from pyrethrum Negative attitude by households/farmers towards adoption of new TIMPs Low uptake before farmers see results
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Awareness creation / capacity building about the TIMP to farmers and traders Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption Continuous capacity building is key to attitude change. Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> Appropriate and favorable policy on adoption of the TIMP Households/Farmers will be willing to adopt the TIMP There will be favorable policy for adoption of the TIMP Environmental conditions will be favorable The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> The technology may not be adopted if women are already overwhelmed with other chores Women have limited access to education, training and extension services Men dominate most decisions at the household and

	community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2. VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported in healing of scalp.
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	<p>KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.</p>
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13.8 Animal feed - pymarc (by-product) (Technology)

2.13.8 TIMP Name	Animal feed - pymarc (by-product)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value added products from pyrethrum in the market and inefficient utilization of pyrethrum by products
What is it? (TIMP description)	<p>Pymarc is a vegetable matter left after extraction of pyrethrins from ground flowers. All pyrethrins are removed at this stage. A feed supplement that reduces intestinal parasites and improves general animal appearance. Small quantities of Pymarc can be mixed with other familiar feed materials such as molasses, salt, bran and hay.</p>  <p>Pymarc (<i>Source: AFA</i>)</p>
Justification	Diversification of value added products from pyrethrum increases production and wide utilization of the pyrethrum byproducts. Byproducts of pyrethrum flowers are used as animal feed.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension providers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media,

	short message services
Critical/essential factors for successful promotion	Linkages with private sector to improve production capacity and empowerment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by households/farmers towards adoption of new TIMPs • Low uptake before farmers see results
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation / capacity building about the TIMP to farmers and traders • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined
Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Consequently the technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services • Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2) VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported in healing of scalp.
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1- ready for upscaling; 2- requires validation; 3- requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega</p>

	P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org
Lead organization and scientists	KALRO Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W. I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L. A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.13.9 Manure (by-product) (Technology)

2.13.9 TIMP Name	Manure (by-product)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Limited value added products from pyrethrum in the market and limited utilization of pyrethrum by products
What is it? (TIMP description)	The waste material after extraction of pyrethrins from ground flowers is used as manure.
Justification	Utilization of pyrethrum flower wastes increases the profitability of pyrethrum. Byproducts of pyrethrum flowers are used as manure.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension providers, agripreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer Field and Business School (FFBS) Agricultural innovation platforms (AIP) Demonstrations - On-farm and on-station Agricultural shows/exhibitions/field days Trainings - workshops/Seminars/Meetings Public and private Extension Agents Farmer-to-farmer extension models Mass media – Electronic and print Publications - posters/brochures/leaflets, manuals Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	Linkages with private sector to improve production capacity and empowerment



Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers and CIGs for activity implementation and promotion • Extension service (public and private) to undertake technology transfer and dissemination • Researchers (for instance from KALRO and universities) for establishing demonstration plots, capacity build county stakeholders, extension workers and farmers on pyrethrum maturity indices • Pyrethrum Processing Company of Kenya (PPCK) to capacity build farmers on the quality of pyrethrum they purchase; provide a market for quality pyrethrum and hence spur growth of the crop
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMP will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of knowledge on value added products from pyrethrum • Negative attitude by households/farmers towards adoption of new TIMPs • Low uptake before farmers see results
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation / capacity building about the TIMP to farmers and traders • Availing data on the economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Involvement of stakeholders such as CIG, CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the TIMP
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Appropriate and favorable policy on adoption of the TIMP • Households/Farmers will be willing to adopt the TIMP • There will be favorable policy for adoption of the TIMP • Environmental conditions will be favorable • The market will be willing and able to absorb the extra output.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet determined

Estimated returns	Reduced losses, better income for farmers
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Consequently the technology may not be adopted if women are already overwhelmed with other chores • Women have limited access to education, training and extension services • Men dominate most decisions at the household and community levels
Gender related opportunities	<ul style="list-style-type: none"> • VMGs have less access to information, technology and knowledge • VMGs have limited access to training • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due to lack of awareness
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Youth and VMGs will need practical observation over time to learn the skill since it is technical
VMG related opportunities	<p>The technology will help:</p> <ol style="list-style-type: none"> 1. women and girls to earn a living 2) VMG to maximize on availability of enterprises to engage in small cottage industries
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers groups in Nakuru County who utilize the TIMP have reported in healing of scalp.
Application guideline for users	KARI 2008. Crop production handbook, oil crops and horticulture
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, KALRO NRI Kakamega P.O. Box 169 - 50100 Kakamega Email: director.nri@kalro.org</p>
Lead organization and scientists	KALRO

	Wayua F.O., Ndambuki J., Obanyi J., Lagat K.R., Mureithi W.I., Ndungu J.N., Ketiem P., Wambua J., Kirigua V.O. and Wasilwa L.A.
Partner organizations	Ministry of Agriculture, Agricultural Universities and Colleges, County governments, Formulators and Processors

2.14 MECHANIZATION OF PYRETHRUM PRODUCTION ACTIVITIES

2.14.1 Improved Pyrethrum Solar Dryers (Technology)

2.14.1 TIMP Name		Improved Pyrethrum Solar Dryers	
Category (i.e. technology, innovation or management practice)		Technology	
A: Description of the technology, innovation or management practice			
Problem to be addressed		Postharvest losses in flowers and pyrethrin content due to improper drying.	
What is it? (TIMP description)		<p>These are equipment that harness solar energy to remove water content (moisture) on pyrethrum flowers for preservation, processing or marketing. The dryers vary in size and designs. A solar dryer can be either stationary or portable in operation. Several designs are available from greenhouse, GROD, hybrid, Wrap etc.</p> <p>The dryers have enclosed chambers/trays for spreading harvested flowers. Dryer roofs vary from dome shape, gable roof with open sides or gable roof with ridge vent. The dryer has a solar collector to tap the solar energy.</p> <p>Polythene sheets (1000 gauge) are used as covering material. The dryer is fitted with temperature sensors to monitor chamber temperature so as to avoid overheating. Extreme temperatures (exceeding 60⁰ C) will cause loss of pyrethrins.</p>	
			
		Portable dryer	Stationary dryer

Justification	<p>Majority of the farmers dry their flowers directly in the sun either on mats, on gunny bags placed on the ground, on raised coffee wire mesh trays and on raised trays with clear polythene cover. The methods lead to loss of flowers and occasionally pyrethrins through overheating.</p> <p>Improved dryers reduce the potential losses and allows flowers to dry during bad weather conditions linked to climate change and variability. The losses of flower through spillage, soiling, fermentation are significantly reduced. The TIMP enhances drying efficiency as flowers take shorter period to dry.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers organizations, County governments, extension staff, co-operative societies, NGOs, agripreneurs and Pyrethrum Processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • The cost of the dryers should be affordable to farmers • Design of the dryers should be easy to handle and manage • Provision of simple and basic information regarding use by farmers • The efficiency of the dryers and the resultant quality of the product after drying • The existence of the distribution channels and platforms • Partnerships established to enhance scale out of the TIMP (support from public and private sector actors)
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County governments – to mobilize, train and funding support • KALRO – develop, validate, train, demonstrate and backstop on the TIMP • Pyrethrum Processing Company of Kenya – scale the technology • Farmers – To adopt and up-scaling the TIMP • Cooperative societies -Train and create awareness
C: Current situation and future scaling up	

Counties where already promoted if any	Nakuru
Counties where TIMP will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • Availability of simple and basic information for use by farmers • Risk of quality loss if not well executed
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Development and provision of dryer fact sheets and leaflets • Provision of user guidelines • Awareness creation and training
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Willingness of farmers to adopt • Alternative use of the dryers (multi-purpose)
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Dryers are easily operated by all gender. They have less weight to allow women and youth easily move from one location to another and maximize on the solar energy radiation • Time saved from drying process allows women, men and youths engage in other socio-economic activities. • Environmentally, the technology reduces emission of GHGs, hence contribute in mitigation of global warming • Favorable policies by both county and national governments will allows farmers more access to the dryers easily (subsidized prices) • Affordable cost increase market of the equipment and scale out • Increased & appropriate distribution networks for the dryers will allow farmers and traders in the last mile easily access

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations

Basic costs	KES 60,000 – KES 250,000 depending on design size
Estimated returns	Farmer gets returns of investment after 8 months of operation
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access credit to purchase the solar dryers. • Women and youth have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge. • Efficiency ensures women and youth have more time to engage in other socioeconomic activities
Gender related opportunities	<ul style="list-style-type: none"> • Dryers provide employment opportunities to men, women and youth • Affirmative action opportunities such as the women and

	youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the solar dryers. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth and women in performing the task using the dryers. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit. • Opportunity exist to establish pyrethrum drying village hubs that are linked to strategic markets in the respective counties and national markets • Opportunities exists to link VMGs to relevant county agricultural stimulus programs and the national programs such as the <i>hustler fund</i>
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • There are great opportunities for the improved solar dryers by stakeholders. Successful trials and demonstration have been done on the cassava value chain • KALRO and Purdue University have existing collaboration on the scaling out of drying technologies
Application guidelines for users	<ol style="list-style-type: none"> 1. Use the operation manual 2. Brochures, Training of Trainers manuals, Fact sheets and flyers
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3- requires further research)	Ready for upscaling
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O Box 100-20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA.</p>

	Email: director.amri@kalro.org
Lead organization and scientists	KALRO - Patrick Ketiem, Janet Obanyi, Eliud Kizito, Lagat Robert, Irene Murithi, Lusike Wasilwa and Violet Kirigua
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.14.2 Pyrethrum harvesters (Technology)

2.14.2 TIMP Name	Pyrethrum harvesters
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Prolonged harvesting of mature flowers leading to losses
What is it? (TIMP description)	<p>The harvester comprises of a mobile chassis moving through flower field. It has two drums rotating in opposite directions approximately vertically spaced axes. Each of the drums has many longitudinal extending, radially projecting, circumferentially spaced grooves which confront one another momentarily during rotation of the drums.</p> <p>The vertical spacing between the axes of the drum is such that there exists a space between confronting grooves that is too great to separate immature flowers from its stem, but is sufficiently small to cut a mature flower from its stem. An air channel communicating with a fan receives detached flowers and conducts them to a storage bin.</p>
Justification	Pyrethrum is one of the oldest and best known source of plant insecticides used for controlling household insects (flies) and pests on agricultural crops. The window for harvesting flowers


	<p>is relatively short when the pyrethrins content is at maximum (92%). Therefore, harvesting is very important and critical for maximum yields. Presently, farmers manually harvest pyrethrum flowers which is very labour and time intensive leading to increased field losses.</p> <p>Pyrethrum harvesters enhance productivity and reduce potential losses. The harvester design has the ability to leave buds and immature flowers in condition for further growth and development.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • KALRO, PPCK, Farmers, CIGs, traders and other small-scale entrepreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • The cost and availability of the machine • The efficiency of the machine in harvesting flowers and the resultant quality of the flowers • The distribution platforms or linkages created • The partnership established to enhance scale out of the technology (public and private sector actors in the crop value chain)
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County governments – to mobilize, train and funding support • KALRO – develop, validate, train, demonstrate and backstop the TIMP • Pyrethrum Processing Company of Kenya – scale the technology • Farmers – To adopt and up-scaling the TIMP • Cooperative societies -Train and create awareness
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma

Challenges in dissemination	<ul style="list-style-type: none"> • The equipment is yet to be introduced and validated • Inadequate knowledge on the machine • Envisaged equipment maintenance by the farmers during the harvesting period
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • KALRO is to design, fabricate and validate the machine • Development of machine fact sheet, leaflet and brochures
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None at the moment since this is a new machine
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • The machine reduces time taken in harvesting as compared to manually harvesting pyrethrum flowers, hence, socially positive contribution for both gender • Favorable policies by county and national government to allows farmers access the equipment by subsidized prices • To maximize market opportunities, appropriate distribution network for the machine. This will allow farmers and traders in the last mile easily access
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1.2M
Estimated returns	It takes up to 2 years for return of investment
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the crops harvesting activities therefore the implement will reduce their work burden therefore allowing them time to engage in other economic activities. • Women and youth have limited access credit to purchase the implement. • Women and youth have limited access to education, training and extension services. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exist for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exist for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Harvesting machines have opportunity to increase productivity through enhanced efficiency, time management and timely operations
Application guidelines for users	<ul style="list-style-type: none"> • Use of machine manual, fact sheet and maintenance schedules
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3- requires further research)	Requires further research
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA. Email: director.amri@kalro.org</p>
Lead organization and scientists	KALRO - Patrick Ketieme, Janet Obanyi, Eliud Kizito, Lagat Robert, Irene Murithi, Lusike Wasilwa and Violet Kirigua
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.14.3 Improved Pyrethrum Tractor-drawn Ridger (Technology)



2.14.3 TIMP Name	Improved pyrethrum tractor-drawn ridger
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Planting of pyrethrum seedlings
What is it? (TIMP description)	The equipment consists of several furrow openers well-spaced as per seedlings row spacing and forms ridges suitable for seedling planting. It is mounted on the tractor (universal three-point linkage system) and the tractor's hydraulic system is used for lifting the unit. The equipment is fitted with depth-gauge wheel to control depth. The equipment improves the

	<p>soil health, reduce erosion and runoff.</p>  <p><i>Improved pyrethrum tractor drawn ridger</i></p> <p>Planting is done on ridges approximately 0.75 to 0.90 meters wide. Ridges helps confine trampling to bottom of furrows. This can save young plants from damage during weeding and may lead to higher yields than on the flat field.</p>
Justification	<p>Majority of farmers plant pyrethrum seedlings on lines manually prepared. A row of pegs is usually placed at each end of the terrace, and strings stretched the length of the terrace between them. Along these lines the planting holes are then made by use of a panga. This is a very labour-intensive process. The design and development of tractor drawn ridger will speed up the pyrethrum planting process. Farmers will only be placing the splits along the dug ridges/furrows (10-15cms) deep with roots straight down.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, Extension staff, County governments, agripreneurs and partners
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Cost of the equipment • Knowledge of the farmers • Efficiency of the equipment and the resultant furrows opened • The distribution platforms or linkages created • The partnership established to enhance scale out of the technology (public and private sector actors in the crop

	value chain)
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> County governments – to mobilize, train and funding support KALRO – develop, validate, train, demonstrate and backstop the TIMP Pyrethrum Processing Company of Kenya – scale the technology Farmers – To adopt and up-scaling the TIMP Cooperative societies -Train and create awareness
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> The equipment is yet to be introduced and validated Inadequate knowledge on the equipment The cost of operation Availability of the equipment
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Design and fabrication of suitable equipment that is affordable to smallholder farmers Training, demonstration and creating awareness
Lessons learned in up scaling if any	<ul style="list-style-type: none"> None
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> The equipment reduces time taken in planting as compared to manually planting of pyrethrum seedlings hence, socially positive contribution for both gender Favorable policies by county and national government to allows farmers access the equipment at subsidized prices To maximize market opportunities, appropriate distribution network for the machine. This will allow farmers and traders in the last mile easily access
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> Computed when the equipment will be operational
Estimated returns	<ul style="list-style-type: none"> Computed when the equipment will be operational
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Men perform most of the pyrethrum planting activities therefore the implement will reduce their work burden. Women and youth have limited access credit to purchase the implement. Women and youth have limited access to education, training and extension services. Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for youth males and

	<p>males in operating the implement.</p> <ul style="list-style-type: none"> Affirmative action opportunities such as the women fund, youth enterprise fund and s hustler fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to purchase the farm implements. VMGs have limited access to training and extension services. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities exist for unemployed youth in operating the implement. Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> Ridgers are very efficient and provides opportunity to increase production
Application guidelines for users	<ul style="list-style-type: none"> Use of machine manual, fact sheet and maintenance schedules
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3- requires further research)	Requires validation
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100-20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA. Email: director.amri@kalro.org</p>
Lead organization and scientists	KALRO - Patrick Ketiem, Janet Obanyi , Eliud Kizito ,Lagat Robert, Irene Murithi Lusike Wasilwa and Violet Kirigua
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.14.4 Motorizing pyrethrum cut-back (Technology)

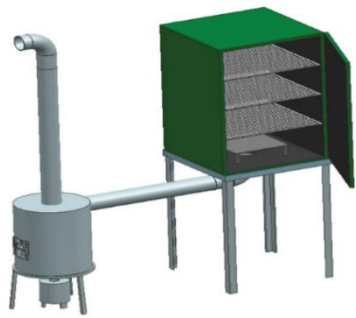
2.14.4 TIMP Name		Motorizing pyrethrum cut-back	
Category (i.e. technology, innovation or management practice)		Technology	
A: Description of the technology, innovation or management practice			
Problem to be addressed		Clipping dried pyrethrum stalks	
What is it? (TIMP description)	The motorized equipment comprises of a sharp edge and sufficiently long enough to allow comfort while cutting or clipping back pyrethrum flower stalks to allow regeneration and second blooming. The equipment is to ensure increased efficiency and scale of operations and subsequently flower yield and hence increased incomes.		
			
	<i>Pyrethrum fields ready for cut-back</i>		<i>Motorized cut-back machine</i>
Justification		<p>The cutting back of old or dried pyrethrum stalks remain a challenge and farmers are utilizing very rudimentary tools such as sickles to cutback the stalks. At the end of every growing season, the flower stalks which remain on the plant gradually dry up.</p> <p>Dry flower stalks require to be cut to allow for growth of new shoots at the onset of next rains. The sickles equipment is not only inefficient but also labour intensive limiting the growth or scale of pyrethrum production.</p> <p>The introduction and testing of motorized pyrethrum cutback equipment will allow farmers to scale production and reduce the cost of operation. The cut dry stalks should be collected and burnt to ease weeding and reduce the risk of harboring pests and diseases.</p>	
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP		Farmers, Extension staff, County governments and partners	
Approaches to be used in dissemination		<ul style="list-style-type: none">Farmer Field and Business School (FFBS)Agricultural innovation platforms (AIP)Demonstrations - On-farm and on-station	

	<ul style="list-style-type: none"> • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Cost of the equipment • Safety features during the operation • Easy accessibility and its durability
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County governments – to mobilize, train and funding support • KALRO – develop, validate, train, demonstrate and backstop the TIMP • Pyrethrum Processors – scale the technology • Farmers – To adopt and up-scaling the TIMP • Cooperative societies -Train and create awareness
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Challenges in dissemination	<ul style="list-style-type: none"> • The cost of equipment • Availability of the equipment • Equipment safety features during the operation
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Design and fabrication of suitable equipment that is affordable to smallholder farmers
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • The equipment reduces time in cutting back stalks manually hence, positive contribution for both gender • Favorable policies by county and national government to allow farmers access the equipment at subsidized prices • To maximize market opportunities, appropriate distribution networks for the equipment. This will allow farmers and traders in the last mile easily access
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 50,000
Estimated returns	After 1 year
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men perform most of the crops cut-back and pruning activities therefore the implement will reduce their work burden therefore allowing them time to engage in other

	<p>economic activities.</p> <ul style="list-style-type: none"> • Women and youth have limited access credit to purchase the implement. • Women and youth have limited access to education, training and extension services • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exist for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Hustler and affirmative action funds opportunities exist for women and youth to access the required credit
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Opportunity to rapidly scale the equipment due to its benefits
Application guidelines for users	1. Use of equipment manual, fact sheet and safety procedures
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3- requires further research)	Requires validation
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA. Email: director.amri@kalro.org</p>

Lead organization and scientists	KALRO - Patrick Ketiem, Janet Obanyi, Eliud Kizito, Lagat Robert, Irene Murithi, Lusike Wasilwa and Violet Kirigua
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.14.5 Biomass dryer (Technology)

2.14.5 TIMP Name	Biomass dryer
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Postharvest losses in flowers and pyrethrin content due to improper drying.
What is it? (TIMP description)	<p>This is a Method of drying using conventional sources of energy (biomass) by generating heat and conveying through a chamber containing harvested flowers. The hot air generated by the combustion of waste biomass are passed through the drying chamber, where the dried flowers are placed on the trays.</p>  <p><i>Biomass drier</i></p>
Justification – problem	<p>Majority of the farmers dry their flowers using open air methods while other uses improved solar dryers. Open air methods are sources of loss of flowers and pyrethrins. Further, with increasing climate change, improved solar dryers may be limited during off-sun periods.</p> <p>The biomass dryers are simplest and most economical method due to its potential to dry products regardless of time and climate conditions (used during off-sun periods) proving good opportunity to meet market demands. Biomass residues can also be easily available leading to low operating costs to the farmer.</p>
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, CIGs, County governments, extension staff, co-operative societies, NGOs, agripreneurs and Pyrethrum Processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Dryer efficient use of thermal energy • The cost of the dryer which should be affordable to farmers • Unequal drying caused by poor airflow distribution in the drying medium • The level of pollution caused by burning of biomass • Dryer handling - should be easy to handle and manage • Availability of simple and basic information for farmers use • The resultant quality of the product after drying • The existence of the distribution channels and platforms • Partnerships established to enhance scale out of the TIMP (support from public and private sector actors)
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County governments – to mobilize, train and funding support • KALRO – develop, validate, train, demonstrate and backstop the TIMP • Processors – scaling up technology and marketing • Farmers – To adopt and up-scaling the TIMP • Cooperative societies -Train and create awareness
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> • All the pyrethrum growing counties in Kenya including Nakuru, Nyandarua, Bomet and Kakamega
Challenges in dissemination	<ul style="list-style-type: none"> • Availability of simple and basic information for use by farmers • Risk of quality loss due to overheating if not well managed (beyond 60°C) • Risk of high pollution caused by biomass/residues burning
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Development and provision of information fact sheets and leaflets • Provision of user guidelines to manage well execution (operation)

	<ul style="list-style-type: none"> • Awareness creation and training • Design Improvement to manage high pollution
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • It is simple, economical and efficient dryer offering great opportunity for adoption
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Dryers are easily operated by all gender. They have less weight to allow women and youth easily move from one location to another and maximize on the solar energy radiation • Time saved from drying process allows women, men and youths engage in other socio-economic activities. • Environmentally, the pollution will adversely impact on the environment and accelerate global warming • Favorable policies by both county and national governments will allows farmers more access to the dryers easily (subsidized prices) • Affordable cost increase market of the equipment and scale out • Increased & appropriate distribution networks for the dryers will allow farmers and traders in the last mile easily access
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 300,000 – KES 850,000 depending on the size
Estimated returns	Farmer gets returns of investment after 1 year of operation
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access credit to purchase the dryer. • Women and youth have limited access to education, training and extension services. • Women have less access to agricultural information, technology and knowledge. • Efficiency ensures women and youth have more time to engage in other socioeconomic activities
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the dryer. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness on the dryer
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth and women in performing the required task using the dryers. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit. • Opportunity exist to establish pyrethrum drying village hubs that are linked to strategic markets in the respective counties and national markets • Opportunities exists to link VMGs to relevant county

	agricultural stimulus programs and the national programs such as the <i>hustler fund</i>
E: Case studies/profiles of success stories	
Success stories from previous similar projects	There are great opportunities to maximize benefits due to low operation costs.
Application guidelines for users	<ol style="list-style-type: none"> 1. Use the operation manual 2. Brochures, Training of Trainers manuals, Fact sheets and flyers
F: Status of TIMP readiness (1- ready for upscaling; 2- requires validation; 3- requires further research)	Ready for validation
G. Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) The Institute Director, Agricultural Mechanization Research Institute (AMRI), Katumani P.O. Box 340 - 90100, Machakos, KENYA. Email: director.amri@kalro.org</p>
Lead organization and scientists	KALRO Patrick Ketiem, Janet Obanyi, Eliud Kizito, Lagat Robert, Irene Murithi, Lusike Wasilwa and Violet Kirigua
Partner organizations	MoALD, KIRDI, MSME, ATDC, Processors and County Governments

2.15 PRETHRUM BUSINESS AND MARKETING SYSTEMS

2.15.1 Contracted production model (Management practice)

2.15.1 TIMP Name	Contracted production model
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	<p>Poor price incentives for the smallholder farmers and lack of market for their produce leading to low production with direct consequence of Kenya's failure to meet global demand.</p> <p>Lack of sufficient volumes and quality of pyrethrum flowers by the processing industry resulting in increased operational costs due to operating below capacity.</p> <p>The prices of pyrethrum dry flowers are low compared to the cost of production. At the time of this document the price of dry</p>

	<p>pyrethrum flower was KES 250-300 per kilogram based on the pyrethrin content that ranges from 0.8 to 3% for the current varieties while the cost of production per kilogram of KES 100 per year. Also what has gone wrong is the failure by the Pyrethrum Processing Company of Kenya (PPCK) to pay farmers for the pyrethrum they delivered within an acceptable timeframe for instance in some cases farmers have waited for four years to receive payments.</p> <p>In the past years Kenya used to supply more than 90% of the world's pyrethrum. But from 2004, the Kenyan Pyrethrum went into tragic decline. Based on that, in the space of the following three years, production had fallen by 91%. Currently, Kenya produces less than 2% of world pyrethrum. It is estimated that current pyrethrum farmers possibly produce 750 - 1,000 tonnes of dried flowers annually (with 500 - 750 tonnes being sold to the informal sector).</p>
What is it? (TIMP description)	<p>In pyrethrum production, a contractual farming is an agreement between farmers and buyers/processors for the production and supply of dried pyrethrum flowers in terms of prices, quantity, quality, time and place.</p> <p>Contract farming gives farmers a guarantee or an assurance that all flowers from will have a ready market, while guaranteeing the buyer of sufficient quality and quantity of the produce. Also in contracted farming, private companies extend lines of credit to producers in the form of farming inputs and technical assistance.</p>
Justification	<p>With revival of the pyrethrum industry, farmers are more reluctant to engage in increased production early in the cycle, while processing factories are limited by the availability of sufficient flowers of right quality.</p> <p>Contract farming, in the presence of a neutral intermediary assures both farmers and processors as well as ensures adherence to the contract terms.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Agripreneurs, research institutions, farmer cooperative societies , PPCK, Processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social

	media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Willingness of farmers – The success of the promotion of the contract farming will depend on the number of farmers interested and how they will embrace the institution • Trust between the producers and the buyers. • Presence of a trusted arbitrator to ensure adherence to the contract terms by all parties involved. • Availability of traders/processors – This is to avoid a reliance on one processor (PPCK) with a result that when the processor fails, the industry as a whole fails. • Competitiveness of pyrethrum to other enterprises in land allocation – Land allocated to pyrethrum production is declining. • Competitiveness of pyrethrum in price – The price of pyrethrum is low compared to other horticultural crops products. • Production volume – Low volume from small scale farmers. • Enforcement and bidding contract farming – Many agricultural production contracts are not bidding and lack mechanisms of enforcement. • Products diversification – Pyrethrum has broad products but currently the diversity in Kenya is narrow.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Contract party and beneficiaries • County extension staff - Capacity building, signing contract • NGOs – Capacity building • Traders – Contract party and beneficiaries • Research institutions – Capacity building • Existing cooperatives – Awareness, financing, mobilization, aggregation centres • Processors – buyers, value addition
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Nyandarua, West Pokot, Laikipia, Kisii, Kiambu and Bomet Counties
Counties where TIMPs will be up scaled	Nakuru, Kiambu, Nyandarua, Nyeri, Laikipia, Meru, Embu, Baringo, Elgeyo Marakwet, West Pokot, TransNzoia, Bungoma (Mt. Elgon), Uasin Gishu, Nandi, Kericho, Bomet, Kisii, Murang'a, Nyamira Counties
Challenges in development and dissemination	<ul style="list-style-type: none"> • Climate change - <i>Drought can lead to plant death and reduces yields.</i> Flowering and flower quality is compromised in times of drought • Production – Declining number of producers, leading to low volumes; scattered farmers also make aggregating produce expensive to the buyer • Marketing – low prices, delayed payments • Enforcement and bidding contract farming - Most of the

	<p>parties in the contracts fail to meet the contractual agreements</p> <ul style="list-style-type: none"> • Market structure – Few processors working with many producers creates reluctance by the farmers to increase area under pyrethrum production • Policy support – enabling county policy to enhance contracted farming as well as support pyrethrum production • Cheaper alternative products e.g. synthetic pesticides, which affect prices offered under contract farming for processors to be competitive • Partners/stakeholders – Many stakeholders with various roles the development and dissemination of pyrethrum technologies, information and management practices • Imported manufactured insecticides - Duty regime that favours importation of finished products at the expense of locally manufactured ones.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Climate change – Development of drought tolerant varieties • Production – Mobilizing and sensitization of farmers to increase volume of production; establishing aggregation centers • Marketing – Improving prices and payment terms • Enforcement and bidding contract farming - Lobbying for contracts which meet the contractual agreements • Market structure – Reviving the pyrethrum sector by involving more processors • Policy support – enabling county policy to enhance contracted farming and pyrethrum production • Competition – Increased awareness on safety (food, human, environment) of plant based pesticides as opposed to synthetic pesticides in Kenya • Partners/stakeholders – Many stakeholders with various roles the development and dissemination of pyrethrum technologies, information and management practices • Imported manufactured insecticides - Duty regime that does not favour importation of finished insecticide aerosols at the expense of locally manufactured ones. • Pyrethrum-based industries – Enabling investments
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Production – It is possible for the farmers to go back to pyrethrum production through guaranteed markets facilitated by the contractual farming • Marketing – Appropriate price is important for the farmers to go back to pyrethrum production • Enforcement of the contract should be witnessed by a different organization • Sensitization of pyrethrin content – This determines the

	price of the dry pyrethrum flowers
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Existing groups of pyrethrum production and marketing • Environmental conditions – Suitable zones for growing pyrethrum; varieties tolerant to the changing climate • Policy conditions – County enabling policy • Market conditions – volume, place, price, promotion, Traders, Agripreneurs, processors
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	No money is required to establish a contract. However, farmers have to adhere to the recommended agronomic practices.
Estimated returns	KES 200-350 per kilogram per year assured through contract farming
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth have less access to knowledge and information on contract farming. • Youth at times do not meet the contract agreements • Women have less access to land for contract farming compared to men. • Women have less access to credit required to purchase the required inputs for contract farming.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women to access the required credit through the women enterprise funds • Engage households in signing of contracts as opposed to only men who may not be the managers of the crop • Opportunities exist for youths to enter into contract farming through renting of land for farming for increased profit margins.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to knowledge and information on contract farming • VMGs have less access to credit required to purchase the required inputs for contract farming • VMGs have less access to land for farming
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for VMGs to access the required credit through the Uwezo funds • Opportunities exist for VMG to enter into contract farming through renting of land for farming for increased profit margins and assured markets • Group formation to increase bargaining power and aggregate
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Coordinated production in sorghum growing areas under contract farming • Increased income

	<ul style="list-style-type: none"> • Wealth creation
Application guidelines for users	<ul style="list-style-type: none"> • Contract manuals
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100-20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos E-mail: director.amri@kalro.org</p>
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

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

2.15.2 Forming farmer producer organizations (Management practice)

2.15.2 TIMP Name	Forming farmer producer organizations
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor market participation and organization due to low market volumes leading to low bargaining power and therefore low productivity
What is it? (TIMP description)	A Farmer Producer Organization (FPO) is a type of Producer Organization (PO) where farmers are the main members and that provide support to small farmers with end-to-end services covering almost all aspects of cultivation from inputs, technical services, product aggregation and access to markets. The pyrethrum farmer producer organization (PFPO) is a voluntary organization controlled by farmer-members who actively participate in making decisions and setting policies.

Justification	In Kenya, farmers are organized into pyrethrum growers' association (KPGA) and cooperatives. Production and aggregation will be done through existing cooperatives, some of which are not necessarily pyrethrum specific. To facilitate support for pyrethrum production, formation/revival of Pyrethrum farmer producer organizations will be paramount. The PFPO aggregates the marginal, small and landless farmers to help increase market linkages to improve production quality and quantity and hence increase farmers' income and economic strength.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers, Processors, Traders, Agripreneurs, cooperatives, KPGA
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • pieces of training - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organization of farmers • Capacity building on group dynamics to ensure good leadership and management of the producer association • Availability of certified seed for pyrethrum production • Adoption of recommended agronomic practices by farmers • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Pyrethrum Processing Company of Kenya (PPCK) • Kenya Pyrethrum Growers Association (KPGA) • Existing cooperatives • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Nyandarua, West Pokot, Laikipia, Kisii, Kiambu and Bomet
Counties where TIMPs will be up scaled	Nakuru

Challenges in development and dissemination -	<ul style="list-style-type: none"> • Disorganized and scattered farmers • Small-scale farming • Lack of trust of leadership and management • Lack of cooperatives in certain pyrethrum growing regions • Unavailability of information • Levels of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganization and scattered farmers – Formation of producer organization • Small-scale farming – allocation of more land to pyrethrum production and aggregation of production to assume large scale-farming, improved productivity • Availability of information – Capacity building of producer groups • Capacity building on leadership and group dynamics • Policy support – Engagement with the county government
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • A reliance on one processor (PPCK) with a result that when the processor fails, the industry as a whole fails and therefore need for the processor diversification • Historical experience with farmer groups and processors affects future decision making on involvement in producer organizations
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Producer group by-laws to govern the operations, Groups to be business oriented and trust be built over time • Environmental conditions – climate smart technologies to enable producers have sufficient production even in times of changing climate patterns • Policy conditions – Available policy support • Market conditions – ability of producer organizations to bargain better prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1000 (to be a member of Kenya pyrethrum growers association)
Estimated returns	KES 200 – 350 per kilogram per year
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women are widely discriminated in rural producer organizations as the men are the owners of the land and hence the registered members, yet it is women who conduct most of the activities • Women also have limited participation and influence in rural producer organizations • Socio-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate

	<ul style="list-style-type: none"> Limited access to assets, resources and services, required to join producer groups Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	<ul style="list-style-type: none"> Men and youth stand to benefit with higher profit margins through collective bargaining during marketing Women groups can access land and produce pyrethrum, and hence be registered in the producer organizations
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs are widely discriminated in rural producer organizations VMGs also have limited participation and influence in rural producer organizations Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	<ul style="list-style-type: none"> VMGs stand to benefit with higher profit margins through collective bargaining and marketing
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Nyandarua County, where farmers market their pyrethrum collectively through self-help group (SHG)
Application guidelines for users	<ol style="list-style-type: none"> Pyrethrum growers' manual Fact sheets The crops (pyrethrum) regulations, 2019
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos E-mail: director.amri@kalro.org</p>
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

- **Gaps:**Performance of farmer organization
- Sustainability of the management of the organization
- Equity distribution in sales and income

2.15.3 Farmers' established quality seed farm model (Management practice)

2.15.3 TIMP Name	Farmers' established quality seed farm model
Category (i.e.technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to limited access to clean planting materials (clones, certified seed or tissue culture material) and in the right quality and quantity.
What is it? (TIMP description)	Pyrethrum nurseries are located in all pyrethrum growing areas in Kenya. The nursery owners provide farmers with pyrethrum seedlings. The nursery seed farm may either be operated by the Regulatory Authority, or licensed to a private operator or farmers.
Justification	Limited access to clean planting material leads to reduced productivity and pyrethrin content of the resultant flowers in pyrethrum. Establishing a quality seed farm is among the stages proposed in the reforms in the pyrethrum sector. This could be done through attracting investors for private seedling nurseries. A minimum of 40 acres of seedling nurseries are required to supply the industry with 60 million seedlings annually. Seedling nursery operators will require a guarantee of contracted sales for seedlings in advance of start-up.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Agripreneurs, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Enforcement of regulations guiding provision of clean planting material in pyrethrum production • Acceptance of smallholder farmers to establish seed farm model • Attract investors for private seedling nurseries • Acceptance of the improved pyrethrum varieties by farmers • Adaptability of the pyrethrum varieties to climate conditions • Favourable prices of pyrethrum
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – investments in pyrethrum nursery production • AFA Pyrethrum Directorate – Regulate nurseries to ensure

	<p>adherence to standards</p> <ul style="list-style-type: none"> • County extension staff - Organization of farmers and technical service delivery • NGOs – Organization of farmers and service delivery • Private sector (local processors, traders and exporters) – Support in input services and providing markets for the pyrethrum production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru
Counties where TIMPs will be up scaled	Pyrethrum growing counties
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming affecting sustainability of investing in nurseries • Insufficient information to stakeholders on the pyrethrum varieties • Group dynamics affecting management and sustainability of clean pyrethrum seed nurseries • Limited access to certified/clean seeds by the nursery managers • Weak or non-existent stakeholder innovation platforms • Low pyrethrum prices • Financial constraints • Low adherence to recommended agronomic practices • Level of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganized and scattered farmers – Formation of farmer groups and modalities for enhancing access to the nurseries • Small-scale farming – allocation of more land to pyrethrum production and aggregation of production to assume large scale-farming. Improved productivity • Inadequate information to stakeholders on the prethrum varieties – Use of promotion channels for instance meetings, stakeholder forums, media, demonstrations and field days • Group dynamics – Capacity building of the groups on group dynamics and management • Lack of seeds – Engagement with researchers, processing companies, farmers and investors • Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Financial constraints – Formation of producer organizations with services including access to financial services and credit facilities • Low pyrethrum prices – Organized marketing channels,

	<p>producer organizations, capacity building on the reduction of production costs, capacity building on farming as a business</p> <ul style="list-style-type: none"> • Level of policy support – Lobbying for the County government support in policy formulations
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Guarantee/give assurance that they will have a ready market for their pyrethrum • Availability of other sources of planting material at cheaper price affects sustainability of clean nurseries • Assist with start-up costs for seedling purchases and inputs (loans or grants from County Governments or National Government through the Ministry of Agriculture)
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – acceptability by the farmers, group dynamics, cultures • Environmental conditions – Enhancing natural resource management • Market conditions – improved prices that lead to increased demand for planting materials • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), • infrastructure, investment environment and guiding recommended sources of planting materials in pyrethrum
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES.100,000 per acre per year to establish the nursery
Estimated returns	4,000 plants in the nursery give approximately 22,000 plants (sufficient for an acre). Each split costs KES.3 giving an income of KES.363,000 per acre from one acre in a nursery
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth may also have limited access to finances to buy the required inputs such as quality planting materials and manure to implement the management practice. • Due to many labour demands on their time, women may not be able to provide adequate time to manage the nurseries. • Women have less access to agricultural information, technology and knowledge on the management practice. • Women have limited access to education, training and extension services.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on establishing nurseries. • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers to establish and manage a pyrethrum nursery. • VMGs have limited access to education, training and extension services. • Limited number of VMGs engaging in pyrethrum production.

	<ul style="list-style-type: none"> • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit • Increased opportunities in pyrethrum production from establishing and managing pyrethrum nursery
E: Case studies/profiles of success stories	
Success stories from pre similar projects	None
Application guidelines for users	<ol style="list-style-type: none"> 1. Pyrethrum growers' manual, 2019 2. Leaflets
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos E-mail: director.amri@kalro.org</p>
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

- Evaluating adoption seed farm models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers
- Farmer accessibility to quality seeds
- Farmers' established quality seed farm model
- Farmer to farmer clonal splits model

2.15.4 Farmer-to-farmer clonal splits model (Management practice)

2.15.4 TIMP Name	Farmer-to-farmer clonal splits model
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Small area under the crop coupled by low productivity occasioned by limited access to clean planting materials and

	in the right quality and quantity; this has led to less than desired area under pyrethrum production
What is it? (TIMP description)	In establishing the seed farm, the 'best available' seeds are collected from farmers, PPCK and KALRO. The seed farm may either be operated by the Regulatory Authority, or licensed to a private operator or farmers. Requirement is that one has a minimum of 6 acres to qualify as a seed farm. The seed farm will need to supply 1,500kg of seed annually to the seedling nurseries
Justification	Among the strategies to increase pyrethrum production is to achieve 2,500 acres of new clonal pyrethrum fields each year through splitting of existing clean clones. Setting up a formal system to encourage farmers to sell clonal splits to their neighbours (farmer to farmer) is among the steps for reforming the pyrethrum sector. If all farmers with clean clones are able to split their clones, the clones can be multiplied by 6 times every 4-5 months.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Agripreneurs, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Enforcement of regulations guiding provision of clean splits clonal material in pyrethrum production • Acceptance of smallholder farmers to establish seed farm model • Acceptance of the improved pyrethrum varieties by farmers • Adaptability of the pyrethrum varieties to climate conditions • Favourable prices of pyrethrum

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – investments in pyrethrum production • County extension staff - Organization of farmers and technical service delivery • AFA Pyrethrum Directorate – regulatory authority • NGOs – Organization of farmers and service delivery • Private sector (local processors, traders and exporters) – Support in input services and providing markets for the pyrethrum production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru
Counties where TIMPs will be up scaled	Pyrethrum growing counties
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the pyrethrum varieties • Unknown clones on farmers' fields • Group dynamics • Lack of seeds • Weak or non-existent stakeholder innovation platforms • Low pyrethrum prices • Levels of production constraints • Level of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganized and scattered farmers – Formation of farmer groups • Small-scale farming – allocation of more land to pyrethrum production and aggregation of production to assume large scale-farming. Improved productivity • Unknown clones – invest in research to identify planting materials within farmers' fields • Inadequate information to stakeholders on the prethrum varieties – Use of promotion channels for instance meetings, stakeholder forums, media, demonstrations and field days • Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms • Low pyrethrum prices - Value addition, organized marketing channels, producer organizations,

	<p>capacity building on the reduction of production costs, capacity building on farming as a business</p> <ul style="list-style-type: none"> • Levels of production constraints – improving credit accessibility, enhancing adoption of Pyrethrum TIMPs • Level of policy support – Lobbying for the County government support in policy formulations.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Having a ready and guaranteed market with favourable prices positively influences decision making in increased pyrethrum production • Assist with start-up costs for seedling purchases and inputs (loans or grants from County Governments or National Government through the Ministry of Agriculture)
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – acceptability by the farmers, group dynamics, cultures • Environmental conditions – Enhancing natural resource management • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), infrastructure, investment environment • Market conditions – reliable market with favourable prices and prompt payments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 100,000 per acre per year
Estimated returns	500 kg per acre per year @ KES 350 per kilogram is KES 175,000
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women and youth may lack ownership of land under pyrethrum to make decision on splits multiplication and sale
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to acquire the required credit • Opportunities exist for youth in establishment of pyrethrum fields through existing clones from other farms
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on the technology . • Lack of clean planting material among VMGs.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire the required credit.
E: Case studies/profiles of success stories	

Success stories from previous similar projects	None
Application guidelines for users	1. Pyrethrum growers' manual, 2019 2. Leaflets
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100 2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos E-mail: director.amri@kalro.org
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

- Evaluating adoption seed farm models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers
- Farmer accessibility to quality seeds

2.15.5 Business Planning Model (Management practice)

2.15.5 TIMP Name	Business Planning Model
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to inadequate business orientation models. Without pyrethrum business planning, the productivity might remain low, leading to decline in volume of sales.
What is it? (TIMP description)	The business model for Kenyan pyrethrum is a written document that outlines the goals of the pyrethrum farm and a roadmap of how to achieve them. The pyrethrum business plan must take into account the other sources of supply versus potential world demand and activities more susceptible to external threats that might hinder achievement of objectives.
Justification	There is need to plan carefully the pyrethrum's sector comeback.

	<p>The business planning model must take account the potential price corrections that may occur when world supply significantly exceeds world demand.</p> <p>The business model must ensure the cost model is better than competing countries (Tasmania, Tanzania, Rwanda and China) as prolonged oversupply will lead to the weaker processors being driven out of the market. The model should also spell out actions in the event the external factors threaten the survival of the business.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, processors, Extension service, PPCK, Research organizations, AFA Pyrethrum Directorate and Agripreneurs
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Education levels among the pyrethrum farmers • Levels of experiences in pyrethrum production • Availability of information on pyrethrum production and marketing
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Demanding opportunities • County extension staff - Capacity building • AFA Pyrethrum Directorate – Regulatory authority • NGOs – Capacity building • Private sector (local traders and exporters) – Demanding opportunities • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Nakuru, Nyandarua, West Pokot, Laikipia, Kisii, Kiambu and Bomet Counties

Challenges in development and dissemination -	<ul style="list-style-type: none"> • Disjointed and scattered farmers • Small-scale production of pyrethrum • Inadequate information to stakeholders on the pyrethrum production and marketing • Levels of weaknesses and threats that cannot be matched by the strengths and opportunities in pyrethrum production and marketing • Levels of policy support • Limited knowledge in business model and interpreting the analysis
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Scattered farmers – Formation of production clusters • Small-scale farming – allocation of more land to pyrethrum production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the pyrethrum production – Developing information hub • Increased weaknesses and threats – Sensitization of stakeholders the challenges; strengthen the strengths and leverage on the opportunities building on regional opportunities • Level of policy support – support in extension services • Hire experts and also make business model as simplified as possible for all to understand
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Increased land area being dedicated to pyrethrum production • Environmental conditions – Favourable climate • Policy conditions – Policy which centralizes smallholder farmer issues • Market conditions – Pricing systems and reduced threats
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 100,000 per acre per year
Estimated returns	500 kg per acre per year @ KES 350 per kilogram is KES 175,000
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women have less access to knowledge and information on planned business model. • Women have less access to land for planned business model. • Women have less access to credit required to purchase the required inputs for planned business model farming. • High illiteracy levels of women leading to lack of record keeping and poor record keeping.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women to access the required credit through the women enterprise funds.

	<ul style="list-style-type: none"> • Opportunities exist for youths to enter into planned business model farming through renting of land for farming for increased profit margins. • Use of simplified tools and analysis accessible to all gender groups. • Opportunities exist for the learned youths to come up with good business plans for themselves and other farmers at a cost.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to knowledge and information on planned business model farming • VMGs have less access to credit required to purchase the required inputs for planned business model farming • VMGs have less access to land for farming
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for VMGs to access the required credit through the Uwezo funds
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Business plans, leaflets
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos E-mail: director.amri@kalro.org</p>
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

- Software for running the business plans matrix
- Efficiency in identifying the opportunities
- Performance of the opportunities

2.15.6 Processing Diversification - Entrepreneurship Model (Management Practice)

2.15.6 TIMP Name	Processing Diversification - Entrepreneurship Model
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to reliance on few processors
What is it? (TIMP description)	Processing diversification - entrepreneurship model involves inclusion of many processors to avoid reliance on the few existing processors and provide incentives for increasing production and productivity through adoption of recommended production practices. Encourage local formulators to invest in new registrations for pyrethrum products in order to maximise the local value add-on on pyrethrum
Justification	Willingness of farmers to increase investment in pyrethrum production is curtailed by fear of another collapse of the world market. Processing diversification increased products and processing options from pyrethrum production and hence acts as an incentive to farmers to increase area under the crop. A target of 20% of all pyrethrum technical grade produced by the processors should be made available to local formulators in order to maximize the revenue and job benefits of pyrethrum
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers, processors, AFA Pyrethrum Directorate
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organization of farmers • Availability of innovations • Policy guidelines and regulation to guide the diversification process • Achievement of profit • Local and regional demand • Quality assurance of diversified products and processors • Access to finance • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Acceptability of innovations • AFA Pyrethrum directorate – Regulatory authority • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators • Processors – Investments
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Nyandarua, West Pokot and Elgeyo Marakwet Counties
Counties where TIMPs will be up scaled	Nakuru, Kiambu, Nyandarua, Nyeri, Laikipia, Meru, Embu, Baringo, Elgeyo Marakwet, West Pokot, TransNzoia, Bungoma (Mt. Elgon), Uasin Gishu, Nandi, Kericho, Bomet, Kisii, Murang'a, Nyamira Counties
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Small-scale farming • Unavailability of information on processing diversification • Levels of profitability in pyrethrum farming • Levels of policy support • Low investment
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Small-scale farming – capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support • Encourage investors
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Farmers are willing to go back to Pyrethrum Farming • The opportunity can quickly re-establish Kenya as a global force in pyrethrum
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Community participation • Environmental conditions – Lack of residual effects makes it ideal for safeguarding global ecosystems • Policy conditions – Investment support and

	<p>guidelines for diversifying processing</p> <ul style="list-style-type: none"> Market conditions – Contract farming, access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES100,000 per acre per year
Estimated returns	500 kg per acre per year @ KES 350 per kilogram is KES 175,000
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> Women lack entrepreneurial skills and capacity to engage in pyrethrum processing diversification Women lack basic reading and numeracy skills so they can run their businesses Women may not apply for loans that can be used to start their businesses and increase their profits due to lack of collateral compared with men
Gender related opportunities	<ul style="list-style-type: none"> Opportunities exist for women to venture in entrepreneurship through the women enterprise fund Women groups have successfully run processing diversification cottage industry in diverse value chains Youth opportunities in pyrethrum processing
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs lack basic reading and numeracy skills so they can run their businesses compared VMGs may lack the business acumen to venture in the marketing innovation model compared VMGs may lack the starting capital
VMG related opportunities	<ul style="list-style-type: none"> Opportunities exist for VMGs to venture in entrepreneurship through affirmative action funds for instance Uwesofund
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> In Nakuru, Nyandarua, West Pokot and Elgeyo Marakwet Counties focusing on reviving pyrethrum farming in Kenya to contribute to a sustainable business eco-system, improved and resilient livelihoods for smallholder farmers and workers engaged in the pyrethrum sub-sector.
Application guidelines for users	<ol style="list-style-type: none"> Pyrethrum growers' manual, 2019 The Crops (Pyrethrum) Regulations, 2019
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
G: Contacts	

Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Centre: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos E-mail: director.amri@kalro.org</p>
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

- Efficacy and suitability of various products
- Sustainability based on market prices
- Innovations for increased productivity

2.15.7 Internet/mobile marketing applications (Management practice)

2.15.7 TIMP Name	Internet/mobile marketing applications
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low income from pyrethrum production due to limited access to markets leading to poor market access.
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, applications, tools, and content delivery systems
Justification	With the increasing change in technology digital marketing is increasingly becoming a requisite for businesses of all types. It is an important tool that farmers engaging in farm business can take advantage of to promote their pyrethrum and hence enhance reach to the buyers. Internet marketing would encourage production of pyrethrum in large scale in different regions adapted to its production, and form as a link to the processors/buyers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings

	<ul style="list-style-type: none"> • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Education levels of the farmers • Levels of experiences in pyrethrum production • Availability of information on pyrethrum production and marketing
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Sellers of pyrethrum production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of pyrethrum • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Nakuru, Kiambu, Nyandarua, Nyeri, Laikipia, Meru, Embu, Baringo, Elgeyo Marakwet, West Pokot, TransNzoia, Bungoma (Mt. Elgon), Uasin Gishu, Nandi, Kericho, Bomet, Kisii, Murang'a, Nyamira Counties
Challenges in development and dissemination	<ul style="list-style-type: none"> • Low digital skills among farmers • Limited number of buyers • Unconsolidated produce for the market • Transport cost for digitally marketed produce • Small-scale farming • Inadequate information to stakeholders on the pyrethrum production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the prethrum production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization

Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Requires stakeholders' involvement • Requires consistence and good customer service • Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Consistence in product quality and good customer care • Environmental conditions – improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 100,000 per acre per year
Estimated returns	500 kg per acre per year @ KES 350 per kilogram is KES 175,000
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women have less access to the required tools such as phones and computer . • Women are more illiterate with limited use of ICT tools compared with men.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for youth to use the ICT tools since most of them are highly literate and have phones or the computers. • Gender opportunities in delivering quality pyrethrum over the internet
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to the required tools such as phones and computer .
VMG related opportunities	<ul style="list-style-type: none"> • Digital marketing increases access to market to the VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> • Mobile applications
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 - 90100 Machakos</p>

	E-mail: director.amri@kalro.org
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

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

2.15.8 Farmer group forums for agricultural advisory services (Management practice)

2.15.8 TIMP Name	Farmer group forums for agricultural advisory services
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low pyrethrum productivity and incomes due to limited access to and channels for advisory services
What is it? (TIMP description)	A platform to disseminate information to farmer on access to seedlings, inputs required, varieties, harvesting period and marketing of pyrethrum. The platform brings under one framework all players in agricultural extension in Kenya for better organization and sharing of information. It is an amalgamation of different large-scale farmers and agricultural stakeholders with farmers. There is bottom-up process of consultation and dialogue between organizations of smallholder farmers and rural producers in the platform
Justification	Reviving of the pyrethrum industry requires active and persistent advisory services in view of the changing climate and changing market conditions. Currently, the pyrethrum advisory services are offered by the pyrethrum processing companies, AFA, KALRO and County department of agriculture in the main pyrethrum growing Counties. With limited access to extension services, empowering farmer group forums for advisory services is important for increasing access to information and improving productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers – to access information • Processors – sensitize and mobilize farmers • County governments – Capacity building and coordination • KALRO – Provide data, capacity building

	<ul style="list-style-type: none"> • AFA Pyrethrum Directorate – regulatory services
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Information - availability of data on quantities of inputs requirements, costs, outputs and value and well packaged • Processors representation – dialogue with farmers • Support by the County governments – Extension services • Farmers representation - appropriateness of the approaches for the dissemination -
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – generate challenges • County governments – provide advisory services, capacity building • NGOs –provide advisory services, capacity building • Processing companies – provide advisory services
C: Current situation and future scaling up	
Counties where already promoted if any	Kericho County
Counties where TIMPs will be up scaled	Nakuru, Kiambu, Nyandarua, Nyeri, Laikipia, Meru, Embu, Baringo, Elgeyo Marakwet, West Pokot, TransNzoia, Bungoma (Mt. Elgon), Uasin Gishu, Nandi, Bomet, Kisii, Murang’a, Nyamira Counties
Challenges in development and dissemination	<ul style="list-style-type: none"> • Scattered farmers – mobility and information flow is limited • Small-scale farming – the land allocated to pyrethrum is declining • Limited packaging of information on pyrethrum production • Inadequate information to stakeholders on the pyrethrum production and marketing – limits opportunities • Levels of policy support – limits the advisory services
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Scattered farmers – formation of production clusters • Small-scale farming – allocation of more land to pyrethrum production and aggregation of production to assume large scale • Invest in compiling, validating, and packaging information on pyrethrum production including clean material • Inadequate information to stakeholders on the pyrethrum production – Developing information hub • Level of policy support – support in extension services

Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – representation by farmers in the platform; farmers with good community relations • Environmental conditions – coverage of areas represented in the platform; advisory that addresses the changing climatic and environmental factors • Policy conditions – Policy support in opportunities selected • Market conditions – attractive market prices to increase adoption
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 100,000 per acre per year
Estimated returns	500 kg per acre per year @ KES 350 per kilogram is KES 175,000
Gender issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women are widely discriminated in farmer groups forums • Women also have limited participation and influence in the farmer groups forums • Socio-cultural norms may limit women's participation and leadership in the farmer groups forums • Ability to package information targeted at various gender groups • Women's double and triple roles means they may not have time to participate in the farmer groups forums
Gender related opportunities	<ul style="list-style-type: none"> • Men, women and youths stand to benefit with higher profit margins through the farmer forum advisory services
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs are widely discriminated in farmer groups forums • VMGs also have limited participation and influence in farmer groups forums
VMG related opportunities	<ul style="list-style-type: none"> • VMGs stand to benefit with higher profit margins through the farmer forum advisory services
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Increased advisory service channels – With the use of the platform there will be stakeholder linkages developed • Increased interaction among stakeholders – this will increase knowledge • Reduction of the impact of limited county government extension services - widened information delivery channels
Application guidelines for users	Pyrethrum growers manual, Training factsheets, and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
G: Contacts	

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Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V., Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

- Expansion of opportunities
- Spread of advisory services

2.15.9 Participatory market research (Management practice)

2.15.9 TIMP Name	Participatory market research
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low income from pyrethrum due to limited knowledge of the opportunities availability in the pyrethrum value chain within the community
What is it? (TIMP description)	A participatory process for identifying market and labour opportunities and helps farmers engage with markets, market identification and selection of attractive enterprise options, based on information gathered from the market and market chain.
Justification	<p>Farmers and other community members in pyrethrum growing regions often have little information and knowledge on the local supply and demand of labour and other opportunities relevant to the pyrethrum value chain. This often leaves many in production, which is often inefficient due to lack of resources or comparative advantage.</p> <p>Participatory market assessments provide community members with active interaction and identification of the various employment opportunities, trends, constraints and hence provide an opportunity to identify how to plug in.</p> <p>The process the community goes through builds confidence among themselves, creates effective communication and uncovers skills that are beneficial for the rural economy, which has been lacking for the pyrethrum value chain.</p>
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, extension, research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of County policies • Availability of trained personnel to conduct participatory market survey and assess the outcome • Willingness of farmers • Rigor – sufficient to provide the community with a clear assessment, yet not too complicated and structured that they lost interest • Availability of targeted markets • Access to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – participants in market research • County extension staff - Capacity building • NGOs – Capacity building • Private sector (processors, local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Nakuru, Kiambu, Nyandarua, Nyeri, Laikipia, Meru, Embu, Baringo, Elgeyo Marakwet, West Pokot, TransNzoia, Bungoma (Mt. Elgon), Uasin Gishu, Nandi, Kericho, Bomet, Kisii, Murang'a, Nyamira Counties
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Limited knowledge on conducting participatory market assessment • PMA requires time • Small-scale farming • Inadequate information on the pyrethrum and pyrethrum-byproducts market outlets. • Lack of skills in the use of communication technologies • Group dynamics • Policy support • Disinterested processing companies
Suggestions for addressing the	<ul style="list-style-type: none"> • Disorganization Disjointed and scattered farmers –

challenges	<p>Organization of producer groups for cooperate marketing.</p> <ul style="list-style-type: none"> • Small-scale farming – Increase hectarage under prethrum production, improving productivity and aggregation of produce to achieve large volume for the market • Inadequate information to stakeholders on the prethrum production and marketing – Capacity building on sources of information. • Group dynamics – Capacity building • Policy support – Support in extension services
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Participatory market research goes beyond production and engages farmers to markets
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Level of education of the community • Environmental conditions – Farmers are in different geographical localities • Policy conditions – Policies supporting formation and functioning of producer organizations • Market conditions – Existing demand
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 100,000 per acre per year
Estimated returns	500 kg per acre per year @ KES 350 per kilogram is KES 175,000
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women are widely discriminated in participatory market research • Women and youth tend to have limited knowledge on local supply and demand including employment opportunities in the pyrethrum value chain and supporting sectors • Women also have limited participation and influence in the farmer groups forums • Socio-cultural norms may limit women's participation and leadership in the participatory market research • Women's double and triple roles means they may not have time to participate in the farmer groups forums
Gender related opportunities	<ul style="list-style-type: none"> • Men, women and youths stand to benefit with higher profit margins through the participatory market research • Vaarious gender groups benefit from knowledge of various employment opportunities available in the pyrethrum and supporting sectors
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs often have little knowledge on local supply and demand including labour are widely discriminated in participatory market research • VMGs also have limited participation and influence in participatory market research
VMG related opportunities	<ul style="list-style-type: none"> • Participatory market research accords VMGs knowledge on employment opportunities in the pyrethrum and supporting sectors • VMGs stand to benefit with higher profit margins through the participatory market research

	<ul style="list-style-type: none"> Participatory market assessments in pyrethrum will provide a platform for interaction between VMGs and other market players in the community
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> Market inclusivity by youth, females and males.
Application guidelines for users	<ol style="list-style-type: none"> Development and dissemination – Involvement of VMGs in the participatory market research Adoption and scaling up – Capacity build VMGs VMGs market inclusivity
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: +254 111 010100</p> <p>2) The Institute Director, KALRO AMRI - Katumani; P.O. Box 340 – 90100 Machakos E-mail: director.amri@kalro.org</p>
Lead organization and scientists	Wambua, J.M., Obanyi, J., Jelagat, F., Wayua, F., Lagat, R., Muriithi, I., Kirigua, V. Wasilwa, L.
Partner organizations	Departments of agriculture and Cooperatives in Counties, processing companies, PPCK, formulators, AFA

Gaps:

- Performance of participatory market research process
- Production and marketing efficiency in pyrethrum
- Equity distribution in income and change in livelihood
- Revival of pyrethrum sector
- Farmers' feasible opportunities

3.1 AGRICULTURAL POLICY OPTIONS

3.1.1 Integrating the Crops Act (Management practice)

3.1.1 TIMP Name	Integrating the Crops Act
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem addressed	Low productivity due to poor payments and market uncertainty in pyrethrum production, leading to low income. Lack of implementation of the contracts and pricing framework has led to low pyrethrum and market uncertainty for the pyrethrum farmers.
What is it? (TIMP description)	The Crops Act is a policy framework that provides instruments and rules for contract farming and payments framework for pyrethrum delivered which ensures that the smallholder farmers are paid on time and according to the pyrethrin content.
Justification	Farmers' produce is paid according to the pyrethrins content. There is payment according to pyrethrins content which is done after analysis of the flowers by the processors. The national minimum pyrethrum is to be determined by the pyrethrum stakeholders where farmers are represented to give their input on production cost. Without input from the farmers, they may be disadvantaged on payments. The instruments and the rules to achieve the policy objectives are not implemented at the farmer level, leading to low farmer payments and increases poaching of produce.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Policy makers • Dealers/ Aggregators • Processing industries • Extension • NGOs • Research institutions • Policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of policy objectives • Availability of policy instruments • Willingness of the stakeholders

	<ul style="list-style-type: none"> • Availability of specific policy instruments • A platform for interaction in Pyrethrum value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – demanding for Pyrethrum policies to support production and marketing • County extension - sensitization of farmers • NGOs – sensitization of farmers • Private sector (Dealers/Processors) – demanding for pyrethrum policies to support production and marketing • Policy makers – Assist in policy making
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Crops Act policy whether National or County • Poor dissemination of information
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of producer organizations as an institution • Policies for increasing productivity • Sensitization of stakeholders • Strengthening pyrethrum value chain • Pyrethrum farmers to benchmark with farmers benefiting from such policy instruments
Lessons learned in up scaling if any	When policy instruments and rules are well implemented, there was an increase in productivity of Pyrethrum in Nakuru County.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Acceptability of the policy instruments and rules by the smallholder farmers • Environmental conditions favorable for sustainable in pyrethrum production • Policy conditions – enabling policy implementation • Market conditions – Access to the market and ability of market to absorb the extra produce arising from the increased yields. • There will be available labour for upscaling activities
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Total variable costs per acre per year- KES 90,000 - 100,000
Estimated returns	Returns after deductions of the total variable costs per acre per year KES 210,000 – 250,000
Gender issues and concerns in development and dissemination, adoption and up-scaling	<ul style="list-style-type: none"> • Development and dissemination – Supporting youth, women and men in production and marketing Pyrethrum • Adoption and scaling – Supporting youth, women and men in production and marketing pyrethrum
Gender related opportunities	<ul style="list-style-type: none"> • Providing incentives to youth, women and men in the production and marketing of pyrethrum. • Increased income by youth women and men • Increased employment by youth, women and men
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Development and dissemination – Supporting VMGs in production and marketing pyrethrum • Adoption and scaling up - Supporting VMGs in production and marketing Pyrethrum
VMG related opportunities	<ul style="list-style-type: none"> • Providing incentives to VMGs in the production and marketing of pyrethrum • Increased income by VMGs • Increased employment by VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) Agriculture and Food Authority P.O. Box 37962 – 00100 Nairobi Email: info@afa.go.ke</p>
Lead organization and scientists	AFA, KALRO Jelagat F., Wambua J., Obanyi J., Kirigua, V.O., Wasilwa, L.
Partner organizations	MoALD, MSME, Agricultural Universities and Colleges, County Government, Formulators, Processors

Gaps:

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

3.1.2 County Integrated Development Planning (Management practice)

3.1.2 TIMP Name		County Integrated Development Planning
Category (i.e. technology, innovation or management practice)	Management practice	
A: Description of the technology, innovation or management practice		
Problem addressed	Low participation of farmers in the County Integrated Development Plan (CIDP) planning process leading to pyrethrum not being given priority in the development programmes. As a result, there is lack of County integration of pyrethrum production and marketing during planning.	
What is it? (TIMP description)	<p>The County Integrated Development Plan (CIDP) is a plan prepared by all counties to guide development over a five-year period. The CIDP contain information on development priorities that inform the annual budget process, annual development plans, the annual county fiscal strategies and the annual budget estimates.</p> <p>The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in pyrethrum production, marketing and processing are considered for development.</p>	
Justification	In the counties where the pyrethrum value chain creates wealth among the smallholder farmers, centralization of the farmer’s agency and voices need to be considered during the County Integrated Development Planning. Failure for the farmers’ participation has led to less optimization of opportunities for pyrethrum to be included in the County budgets for support in the production of pyrethrum.	
B: Assessment of dissemination and scaling up/out approaches		
Users of TIMP	<ul style="list-style-type: none">• Farmers• Dealers / Aggregators• Processors• Extension• NGOs• Research institutions• Policy makers	
Approaches to be used in dissemination	<ul style="list-style-type: none">• Farmer Field and Business School (FFBS)• Agricultural innovation platforms (AIP)	

	<ul style="list-style-type: none"> • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of agricultural policies and specific Pyrethrum based policies • Identified Issues in pyrethrum business • Specific policy objective statement • A platform for interaction in Pyrethrum value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Demanding pyrethrum policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (aggregators/ dealers and Processors) – Demanding pyrethrum policies to support production and marketing • Research institutions – Sensitization of stakeholders • Policy makers – Implementation of policies
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the agricultural policies whether National or County • Pyrethrum production are specific to agro-ecological zones and not all the Counties in Kenya grow Pyrethrum
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Formation of producer organizations as an institution • Policies for increasing productivity • Sensitization of stakeholders • Poorly established Pyrethrum value chain – strengthening pyrethrum value chain • Pyrethrum production are specific to agro-ecological zones and not all the sub- counties in the County grow pyrethrum

Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is increase in Pyrethrum productivity • There is Pyrethrum business in the Counties which recognize the potential of Pyrethrum during the County Integrated Development Planning • There is interest by NGOs, farmer development support • There is potential for investors to construct processing facilities in the County
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – acceptability of the policy instruments and rules by the smallholder farmers of pyrethrum • The market will be willing and able to absorb the extra produce arising from the increased yields. • There will be available labour during upscaling activities • Environmental conditions will be favourable for crop growth during upscaling activities • Policy environment will be enabling for upscaling of the TIMP • The market will be willing and able to absorb the extra produce arising from the increased yields
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs per acre per year- KES 90,000 - 100,000
Estimated returns	Returns after deductions of the total variable costs per acre per year KES 210,000 – 250,000
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in the development process of the county integrated plans • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Inadequate representation of VMGs in the development process of the county integrated plans • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	<ul style="list-style-type: none"> • Participation in the process of developing the county integrated development plans
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None

Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) Agriculture and Food Authority P.O. Box 37962 – 00100 Nairobi Email: info@afa.go.ke</p>
Lead organization and scientists	AFA, KALRO Jelagat F., Wambua J., Obanyi J., Kirigua, V.O., Wasilwa, L.
Partner organizations	MoALD, MSME, Agricultural Universities and Colleges, County Government, Formulators, Processors

GAPS

- Adoption of policy options
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers
- Farmer accessibility to production inputs

3.1.3 National Agricultural Policy Strategy Framework (Management Practice)

3.1.3 TIMP Name	National Agricultural Policy Strategy Framework
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low pyrethrum productivity due to lack of policy on access to farming inputs (quality planting materials). Access to the clonal and varietal materials has been difficult for all pyrethrum stakeholders leading to low productivity.
What is it? (TIMP description)	The National Agricultural policy strategy framework provides instruments and rules on access to varietal and clonal materials by all stakeholders.

Justification	<p>A policy and strategy on pyrethrum farming inputs is crucial for increased productivity and wealth to farmers. Access to these inputs by pyrethrum farmers has been a challenge due to lack of policy on access to quality inputs.</p> <p>Issues of ownership and custody of the varieties is also a challenge. Lack of access to these inputs has led farmers planting poor quality materials resulting in low production and thus affecting their wealth and the revival of the sub sector.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Policy makers • Traders • Processing industries • Extension • NGOs • Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of specific Pyrethrum based policies on access to inputs • Applied and adaptive Research to test, validate and release improved pyrethrum varieties • A platform for interaction in pyrethrum value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – demanding policies to support production and access to quality inputs • County extension staff - sensitization of farmers • NGOs – sensitization of farmers • Private sector (dealers and processors) – demanding pyrethrum inputs policies to support access to quality inputs and production • Research institutions – sensitization of stakeholders • Policy makers – assist in policy making

C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipia, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in development and dissemination	<p>Value Chain: Pyrethrum yields remain low and total domestic production is unable to satisfy demand by processors leading to growing imports of raw materials.</p> <p>Aggregation: Aggregation models including farmer groups/cooperatives - suffered after the decline in pyrethrum production, wherein many farmers abandoned pyrethrum production. These weak organizations limit the bargaining power of the farmers.</p> <p>Financial Incentives: The government provides only limited support to pyrethrum producers through subsidized limited extension, planting materials, solar dryers and research. Pyrethrum processors are investing backward in their supply chains to increase farmer production by financing access to farm inputs which include planting materials, fertilizers, solar dryers and providing extension services.</p>
Suggestions for addressing the challenges	<p>Value Chain: Enhance productivity and total production through improved varieties, solar dryers, fertilizers and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors.</p> <p>Standards: Existing pyrethrum standards and classifications should be redesigned to align with Kenya's climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training.</p> <p>Aggregation: Partnerships between farmer groups/cooperatives and pyrethrum producers can strengthen market linkages, set guaranteed pyrethrum for farmers, and enable access to high-yielding seedlings and other climate-smart inputs.</p> <p>Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based pyrethrum payments, including CSA-criteria, while offering comprehensive service provision for</p>

	producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.
Lessons learned in up scaling if any	When policy instruments and rules are well implemented, there was an increase in productivity of pyrethrum.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – acceptability of the policy instruments and rules by the smallholder farmers of pyrethrum • The market will be willing and able to absorb the extra produce arising from the increased yields. • There will be available labour during upscaling activities • Environmental conditions will be favourable for crop growth during upscaling activities • Policy environment will be enabling for upscaling of the TIMP • The market will be willing and able to absorb the extra produce arising from the increased yields
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Increased returns are expected in the pyrethrum value chain once this management practice is fully instituted.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy validation process.
Gender related opportunities	Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy validation process.
VMG related opportunities	Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks that support their participation.
E: Case studies/profiles of success stories	
Success stories from previous	None

similar projects	
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Further Research
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) Agriculture and Food Authority P.O. Box 37962 – 00100 Nairobi Email: info@afa.go.ke</p>
Lead organization and scientists	AFA, KALRO Jelagat F., Wambua J., Obanyi J., Kirigua, V.O., Wasilwa, L.
Partner organizations	MoALD, MSME, Agricultural Universities and Colleges, County Government, Formulators, Processors

Gaps:

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers of Pyrethrum
- Farmer accessibility to production inputs
- Impact on pyrethrum

3.1.4 Agricultural Policy Strategy Framework (Management practice)

3.1.4 TIMP Name	National Agricultural policy strategy framework
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Neglect of smallholder farmers' agencies in Agricultural policy making in Kenya. These farmers are framed as having no innovations or insights to offer. Indeed, they are considered to have little agency beyond the adoption of modernizing innovations that are believed to transform agriculture and build livelihoods.
What is it? (TIMP description)	National Agricultural policy framework that includes innovations, technologies and management practices from farmers and other value chain actors into agriculture policies and strategies.
Justification	Agricultural policy making in Kenya overlook diverse agricultural transformation pathways that are sustainable in local social/economic conditions and based on smallholder farmers'

	knowledge leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. The pathways through which smallholder farmers' perspectives and knowledge can be included in policy going forward
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Policy makers • Dealers/ traders • Processors • Extension • NGOs • Research institutions • Policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of specific pyrethrum-based policies • Applied and adaptive Research to test, validate and release improved pyrethrum varieties • A platform for interaction in pyrethrum value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Demanding pyrethrum policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Pyrethrum policies to support production and marketing • Research institutions – Sensitization of stakeholders • Policy makers – Assist in policy making
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in development and dissemination	<ul style="list-style-type: none"> • Value Chain: Pyrethrum yields remain low and total domestic production is unable to satisfy demand by manufacturers

	<p>leading to growing imports of raw materials.</p> <ul style="list-style-type: none"> • Standards: Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are does not exist. • Aggregation: Aggregation models including cooperatives—suffered after the downturn in Pyrethrum production, wherein many farmers abandoned pyrethrum production. These weak organizations provide few services to farmers and limited bargaining power. • Financial Incentives: The government provides only limited support to pyrethrum producers through subsidized inputs and research. Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.
Suggestions for addressing the challenges	<p>Value Chain: Enhance productivity and total production through better planting materials, CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors.</p> <p>Standards: Existing pyrethrum standards and classifications should be redesigned to align with Kenya’s climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and extension training.</p> <p>Aggregation: Partnerships between farmer cooperatives/ groups and pyrethrum producers can strengthen market linkages, set guaranteed pyrethrum for farmers, and enable access to resilient, high-yielding seedlings and other climate-smart inputs. Access to farmers own technologies</p> <p>Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement pyrethrin-based pyrethrum payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.</p>
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – acceptability of the policy instruments and rules by the smallholder farmers of pyrethrum • The market will be willing and able to absorb the extra produce arising from the increased yields. • There will be available labour during upscaling activities • Environmental conditions will be favourable for crop growth during upscaling activities

	<ul style="list-style-type: none"> Policy environment will be enabling for upscaling of the TIMP The market will be willing and able to absorb the extra produce arising from the increased yields
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Increased returns are expected in the pyrethrum value chain once this management practice is fully instituted.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> Inadequate representation of youth and women in the development process of the national agricultural policy strategy framework Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> Inadequate representation of VMGs in the development process of the national agricultural policy strategy framework Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities exist for VMGs to participate in the process of developing the county integrated development plans
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) Agriculture and Food Authority P.O. Box 37962 – 00100 Nairobi Email: info@afa.go.ke</p>
Lead organization and scientists	AFA, KALRO Jelagat F., Wambua J., Obanyi J., Kirigua, V.O., Wasilwa, L.
Partner organizations	MoALD, MSME, Agricultural Universities and Colleges, County Government, Formulators, Pyrethrum processors

Gaps

- Adoption of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers of pyrethrum
- Farmer accessibility to production inputs
- Performance of the farmer technologies
- Impact on pyrethrum

3.1.5 Policy Cycle (Management practice)

3.1.5 TIMP Name	Policy Cycle
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low Pyrethrum productivity due to the development of agricultural policies not relevant to the problem emergency in pyrethrum and also without staged follow-up.
What is it? (TIMP description)	The policy cycle process is normally conceptualized as sequential parts or stages. These are (1) problem emergence, (2) agenda setting, (3) consideration of policy options, (3) decision-making, (5) implementation, and (6) evaluation. Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. These individual steps provide a frame work and antedates any forthcoming issues related to policy development
Justification	Why is a policy cycle an appropriate tool for making policies related to pyrethrum? 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. 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. Many organizations aim to complete policies using the policy cycle as an optimal model.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Dealers/Traders • Processors • Extension • NGOs • Research institutions • Policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on-station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents

	<ul style="list-style-type: none"> • Farmer-to-farmer extension models • Mass media – Electronic and print • Publications - posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media, short message services
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • The stages of problem emergence, formulation, implementation and evaluation • Applied and adaptive Research to test, validate and release improved pyrethrum varieties • A platform for interaction in pyrethrum value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – generate issues • County extension - capacity building • NGOs – capacity building • Private sector (local traders/dealers and processors) – generate issues • Research institutions – capacity building • Policy makers – Draft policies
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Kisii, Nyamira, Meru, Embu, Kiambu, Nyeri, Nyandarua, Trans Nzoia, Laikipa, Nandi, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok, Kericho, Bungoma
Counties where TIMPs will be up scaled	All pyrethrum growing counties including Nakuru, Nyandarua, Bomet, Kakamega
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Scattered and lack of organized economic farmer groups • Small-scale farming • Inadequate information to stakeholders on issues • Poorly established pyrethrum value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Scattered and lack of organized economic farmer groups – issues on formation of producer organizations as an institution • Small-scale farming – sensitization on aggregation • Inadequate information to stakeholders – Sensitization on the roles of each policy cycle stages • Poorly established pyrethrum value chain – strengthening Green gram value chain
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions –having in place a value chain system • Environmental safety considerations • There will be available labour for upscaling activities

	<ul style="list-style-type: none"> • Environmental conditions will be favourable for crop growth during upscaling activities • Policy environment will be enabling for upscaling of the TIMP • The market will be willing and able to absorb the extra produce arising from the increased yields.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Increased returns are expected in the pyrethrum value chain once this management practice is fully instituted.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy validation process.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness 1. Ready for up scaling, 2. Requires validation, 3. Requires further research	Requires validation
G: Contacts	
Contacts	<p>1) The Centre Director, KALRO Molo P.O. Box 100 - 20106 MOLO Email: kalro.molo@kalro.org KALRO Call Center: 0111010100</p> <p>2) Agriculture and Food Authority P.O. Box 37962 – 00100 Nairobi</p>

	Email: info@afa.go.ke
Lead organization and scientists	AFA, KALRO Jelagat F., Wambua J., Obanyi J., Kirigua, V.O., Wasilwa, L.
Partner organizations	MoALD, MSME, Agricultural Universities and Colleges, County Government, Formulators, Processors

- **Gaps:**Analysis of policy model
- Impact on the new policy on pyrethrum production and marketing



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