Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Kale 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

Kenya Climate-Smart Agriculture Project (KCSAP) tasked the Kenya Agricultural and Livestock Research Organization (KALRO) with the implementation of the project's Component 2 on 'Strengthening Climate-Smart Agricultural Research and Seed Systems'. The component activities are geared towards the development, validation, adoption and delivery of context specific climate smart agriculture (CSA) technologies, innovation and management practices (TIMPs). It is also responsible for development of sustainable seed production and distribution systems of priority agricultural value chains to enhance availability and access improved seeds, animal breeds and fingerlings by target beneficiaries. Against this background, KALRO and her National Agricultural Research System (NARS) partners have developed, validated and availed CSA TIMPs for dissemination and adoption. This document provides a detailed inventory of TIMPs that have been developed in Kale value chain.

Extensive information from research and background data has been used to develop this TIMPs inventory. To disseminate the TIMPs, a Training of Trainers (ToT) manual has been developed. The design of the manual takes into consideration the delivery system, partners and their roles, duration of training and logical flow of the modules. The training modules have uniform outline that ensures every aspect of the TIMPs are fully covered in way that the trainees can absorb and relate to. Various delivery methods are deployed and where possible demonstrations and practical work are incorporated to enable the trainees learn by participating in the actual field activities. The use of this TIMPs inventory is expected to contribute to achievement of the envisaged KCSAP's project 'Triple Wins' of increased productivity, enhanced resilience and reduction of greenhouse gases emissions. Thus this TIMPs inventory is to be used in conjunction with the respective Kale ToT Manual.

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

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

PREFACE

The Kenya Climate-Smart Agriculture Project (KCSAP) is a Government of Kenya project with support from both the World Bank and the government. The project runs for five years and implemented in 24 counties, mainly in the arid and semi-arid lands (ASALs), at an approximate cost of KES 25 billion. The project development objective (PDO) is "to increase agricultural productivity and build resilience to climate change risks in the targeted smallholder farming and pastoral communities, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response." This objective is to be achieved through the implementation of five key components, which are: 1) Upscaling Climate-Smart Agricultural Practices, 2) Strengthening Climate-Smart Agricultural Research and Seed Systems, 3) Supporting Agro-weather, Market, Climate, and Advisory Services, 4) Project Coordination and Management and 5) Contingency Emergency Response.

Component 1 involves facilitating the empowering of farmers and communities to adopt technologies, innovations and management practices (TIMPs) to achieve the Climate Smart Agriculture (CSA) triple-wins of; increased productivity, enhanced resilience (adaptation), and reduced Greenhouse gas (GHG) emissions (mitigation). Component 2 is tasked with the responsibility of providing the TIMPs. Therefore, it supports the development, validation, and adoption of context specific CSA TIMPs to target beneficiaries under Components 1 and 3.

To catalyze uptake of TIMPs, Kenya Agricultural and Livestock Research Organization (KALRO) in conjunction with partners in the National Agricultural Research Systems (NARS) and Consultative Group for International Agricultural Research (CGIAR) compiled inventories of TIMPs for the prioritized value chains. The crop-based value chains are 19 and include roots and tubers (cassava, potato), pulses (dry beans, green gram and pigeon peas), vegetables (tomato, onion, indigenous vegetables, kale and cabbage), cereals (sorghum, millet, maize, teff) nuts (cashew nut), fruits (banana, mango, water melon) and fibre (cotton). Those that are animal production based are five (5) and include apiculture, indigenous chicken (meat and eggs), dairy (cattle and camel), red meat (cattle, sheep and goats) and aquaculture. Also, there are three (3) cross cutting themes on pastures and fodder, natural resource management, and animal health. The TIMPs have been categorized into those ready for upscaling and those requiring validation. Furthermore, gaps that required further research and development of TIMPs have been identified. Training of Trainers' (ToT) manuals focusing on TIMPs that are ready for upscaling for each of the value chains have been subsequently developed to form the basis of training county extension staff, service providers and lead farmers. Those trained are in turn expected to cascade the training to beneficiaries in the targeted smallholder farming, agro-pastoral and pastoral communities in the 24 project counties of Marsabit, Isiolo, Tana River, Garissa, Wajir, Mandera, West Pokot, Baringo, Laikipia, Machakos, Nyeri, Tharaka Nithi, Lamu, Taita Taveta, Kajiado, Busia, Siaya, Nyandarua, Bomet, Kericho, Kakamega, Uasin Gishu, Elgeyo Marakwet and Kisumu.

KALRO, having the responsibility of implementing the activities under Component 2, has been instrumental in using its information resources and those of partners and collaborators to come up with the inventories of TIMPs and corresponding ToT manuals. Use of these information resources coupled with the accompanying training and contribution of the other project components will go a long way in enabling KCSAP to meet its development objectives.

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

Francis Muthami
National Project Coordinator
Kenya Climate-Smart Agriculture Project

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AEZ	Agro-ecological zone
ASALs	Arid and Semi-Arid Lands
B	Boron
CA	Conservation Agriculture
CCPs	Critical control points
CIGs	Common Interest Group
CLs	Critical limits
CC	Climate Change
CSA	Climate Smart Agriculture
FFB	Farmer Field and Business School
FSMS	Food Safety Management System
GAPs	Good Agricultural Practices
ha	Hectare
HACCP	Hazard Analysis Critical Control Points
HCD	Horticulture Crop Directorate
IDM	Integrated Disease Management
INRM	Integrated Natural Resource Management
IPM	Integrated Pest Management
ISFM	Integrated Son Fertility management
IWM	Integrated Weed Management
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Project
kg	Kilogram
TIMPs	Technologies, Innovations and Management Practices
ToT	Training of Trainers
VMG	Vulnerable and Marginalized Groups
SWOT	Strengths Weaknesses Opportunities and Threats
NGO	Non-Governmental Organizations
CIDP	County Integrated Development Plan
NARI	National Agricultural Research Institutions
IFPRI	The International Food Policy Research Institute
GHG	Green House Gases
IMM	Integrated Manure Management
CBO	Community Based Organization

1.0 DEFINITION OF TERMS AND SUMMARY TABLES OF KALE

1.1 DEFINITION OF TERMS

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

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

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

1.2 SUMMARY OF TIMPS IN THE KALE VALUE CHAIN (VC)

The inventory process identified 100 TIMPs comprising 38 technologies, 5 innovations and 57 management practices, distributed among the 11 sub-themes, as indicated in the table 1.

Table 1 Summary of Kale TIMPs

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Kale	Improved Kale varieties	8	0	0
Kale	Kale seed system	1	2	0
Kale	GAPs and Food Safety	0	0	2
Kale	Agronomic management practices	3	1	4
Kale	Soil Fertility & Soil and Water Management	6	2	11
Kale	Kale Crop health	2	0	25
Kale	Postharvest management	5	0	3
Kale	Kale Value addition	3	0	0
Kale	Mechanization of Kale production activities	10	0	0
Kale	Kale business and Marketing	0	0	8
Kale	Agricultural Policy	0	0	4
Total		**38**	**5**	**57**

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

Commodity/VC	Sub-Theme	Ready for upscaling	Require validation	Further Research
Kale	Improved Kale varieties	7	1	0
Kale	Kale seed system	1	1	1
Kale	GAPs and Food Safety	2	0	0
Kale	Agronomic management practices	7	1	0
Kale	Soil Fertility Soil and Water Management	12	5	2
Kale	Kale Crop health	25	2	0
Kale	Postharvest management	4	4	0
Kale	Kale Value addition	0	2	1
Kale	Mechanization of Kale production activities	7	1	2
Kale	Kale business and Marketing	1	7	0
Kale	Agricultural Policy	0	0	4
Overall Total		**66**	**24**	**10**

1.3 SUMMARY OF STATUS OF TIMPS IN KALE VALUE CHAIN

The inventory process resulted in 66 TIMPs that are ready for up scaling, 24 TIMPs that require validation and 10 TIMPs that require further research in the sub-themes, as indicated in Table 2.

Table 3: Inventory of Kale TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Improved Kale varieties	2.1.1 Collards Southern Georgia	Technology	Ready for Up scaling
	2.1.2 Thousand headed	Technology	Ready for Up scaling
	2.1.3 Marrow stem	Technology	Ready for Up scaling
	2.1.4 Kinale	Technology	Ready for Up scaling
	2.1.5 Tosha	Technology	Ready for Up scaling
	2.1.6 Moss curly Kale	Technology	Ready for Up scaling
	2.1.7 Mfalme F1 sukuma wiki	Technology	Ready for Up scaling

	2.1.8 Ethiopian Kale	Technology	Requires validation
2.2 Kale seed system	2.2.1. Own seed selection	Innovation	Ready for up scaling
	2.2.2. Informal Seed System	Innovation	Requires validation
	2.2.3. Formal Seed System	Innovation	Further research
2.3 Good Agricultural Practices and Food Safety Management Systems	2.3.1 Good Agricultural Practices	Management practice	Ready for up scaling
	2.3.2 Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Kale in Kenya	Management Practice	Ready for Up scaling
2.4 Agronomic management practices	2.4.1 Flat bed/ sunken bed/ raised bed nurseries	Technology	Ready for upscaling
	2.4.2 Seed trays for clean planting materials	Technology	Ready for up scaling
	2.4.3 Exclusion nets for farms and Nurseries (and farms)	Technology	Requires Validation
	2.4.4 High health nursery	Innovation	Ready for upscaling
	2.4.5 Site selection and land preparation	Management practice	Ready for upscaling
	2.4.6 Recommended spacing in the field for Kale	Management practice	Ready for upscaling
	2.4.7 Kale and Legumes intercrops	Management practice	Requires Validation
	2.4. 8 Crop Rotation	Management practice	Ready for upscaling
2.5 Soil fertility management	2.5.1 Intergrated Manure Management	Complimentary Technology	Ready for upscaling
	2.5.2 ISFM	Complimentary Technology	Requires Validation
	2.5.3 Rapid Soil Testing services	Innovation	Requires Validation
	2.5.4 Low Cost Composting	Complimentary Technology	Requires Validation
	2.5.5 Contour bands	Management practice	Ready for Up-scaling
	2.5.6 Zai pits	Technology	Ready for Up-scaling
	2.5.7 Bench Terraces	Management practice	Ready for Up-scaling
	2.5.8 Stone lines	Management practice	Ready for Up-scaling

	2.5.9 Retention Ditches	Management practice	Ready for Up-scaling
	2.5.10 Grass Strips	Management practice	Ready for Up-scaling
	2.5.11 Tied Ridges / Ridging / Earthing	Management practice	Ready for Up-scaling
	2.5.12 Rain water Harvesting Systems	Management practice	Ready for Up-scaling
	2.5.13 Conservation Agriculture	Management practice	Ready for Up-scaling
	2.5.14 Kale-legume intercrop	Management practice	Requires further research
	2.5.15 Mulching	Management practice	Requires further research
	2.5.16 Drip Irrigation in Kale production for small scale farmers	Technology	Ready for Up-scaling
	2.5.17 Solar Irrigation	Innovation	Requires validation
	2.5.18 Hydroponics	Complimentary Technology	Ready for Up-scaling
	2.5.19 Agroforestry for soil fertility	Management practice	Requires validation
2.6 Kale Crop Health (Pests)	2.6.1 Scouting for pest identification and control	Management practice	Ready for upscaling
	2.6.2 Integrated management of Diamond back moth	Management practice	Ready for upscaling
	2.6.3 Integrated management of Aphids	Management practice	Ready for up scaling
	2.6.4 Use of traps in Aphid Management	Management practice	Ready for up scaling
	2.6.5 Integrated Management of soil pests (cutworms & cabbage root maggot)	Management practice	Ready for up scaling
	2.6.6 Integrated management of cabbage web worm	Management practice	Ready for upscaling
	2.6.7 Integrated management of the cabbage saw fly & cabbage looper	Management practice	Ready for upscaling;
	2.6.8 Integrated management of thrips	Management practice	Ready for upscaling
	2.6.9 Use of Natural enemies (Parasitoids) for management of diamond back moth on Kale	Management practice	Ready for upscaling
	2.6.10 Integrated management of damping off disease	Management practice	Ready for upscaling
	2.6.11 Integrated management of powdery mildew disease	Management practice	Ready for upscaling

	2.6.12 Integrated management of black rot disease	Management practice	Ready for upscaling
	2.6.13 Integrated management of the leaf spots	Management practice	Ready for upscaling
	2.6.14 Integrated management of cauliflower mosaic disease	Management practice	Ready for upscaling
	2.6.15 Integrated management of club root disease	Management practice	Ready for upscaling
	2.6.16 Integrated management of white mold disease	Management practice	Ready for upscaling
	2.6.17 Integrated management of white rust disease	Management practice	Ready for upscaling
	2.6.18 Integrated management of black leg disease	Management practice	Ready for upscaling
	2.6.19 Integrated management of bacterial soft rots	Management practice	Ready for upscaling
	2.6.20 Integrated management of downy mildew	Management practice	Ready for upscaling
	2.6.21 Integrated Weed Management	Management practice	Ready for Upscaling
	2.6.22 Intercropping	Management practice	Requires Validation
	2.6.23 Mulching	Technology	Ready for Upscaling
	2.6.24 Chemical weed control	Technology	Ready for Upscaling
	2.6.25 Mechanical weed control	Management Practice	Ready for Up scaling
	2.6.26 Crop Rotation	Management practices	Requires Validation
	2.6.27 Safe use of Herbicides	Management practices	Ready for Up scaling
2.7 Harvest and Postharvest management	2.7.1 Harvesting Procedure	Management practice	Requires validation
	2.7.2 Post handling practices	Management practice	Ready for upscaling
	2.7.3 Charcoal cooler	Technology	Requires validation
	2.7.4 Zero Energy Cooler	Technology	Requires validation
	2.7.5 Modified Atmospheric Packaging	Technology	Requires validation
	2.7.6 Solar drying	Technology	Ready to Upscale
	2.7.7 Grading and sorting	Management practice	Ready for upscaling
	2.7.8 Dehytray Technology	Technology	Ready for upscaling

2.8 Kale Value Addition	2.8.1 Kale Flour	Technology	Require validation
	2.8.2 Kale Juice	Technology	Require further research
	2.8.3 Chopped Kale	Technology	Require validation
2.9 Mechanization of Kale production activities	2.9.1 Power tiller	Technology	Ready for up scaling
	2.9.2 Wheeled tractor	Technology	Ready for up scaling
	2.9.3 Moldboard plough	Technology	Ready for up scaling
	2.9.4 Disc Harrow	Technology	Ready for up scaling
	2.9.5 Multi-function seedbed ridging machine	Technology	Require further research
	2.9.6 Kale direct drill	Technology	Ready for up scaling
	2.9.7 Kale Trans planter	Technology	Ready for up scaling
	2.9.8 Seed tray planter	Technology	Require validation
	2.9.9 Motorized Sprayer	Technology	Ready for up scaling
	2.9.10 Fertilizer spreader	Technology	Require further research
2.10 Kale Value Chain Business and marketing	2.10.1 Transformative model of Kale production	Management practice	Requires Validation
	2.10.2. Building a business plan for Kale production	Management practice	Requires validation
	2.10.3 Profitability Analysis	Management practice	Ready for upscaling
	2.10.4 Market innovation model	Management practice	Requires validation
	2.10. 5 Collective marketing	Management practice	Requires validation
	2.10.6 Contracted production model	Management practice	Requires validation
	2.10. 7. Internet/mobile marketing	Management practice	Requires validation
	2.10.8 Market Research	Management practice	Requires validation
22.11. Agricultural Policy options influencing Kale enterprise	2.11.1. National Agricultural Strategies supporting Kale production and marketing	Management practices	Requires Validation
	2.11.2. County Integrated Development Plan (CIDP) for supporting Kale production	Management practices	Requires Validation
	2.11.3 Policy instruments relating to Kale Production	Management practices	Requires Validation

	2.11.4 Policy Cycle	Management practices	Requires Validation

2.0 DETAILED KALE VALUE CHAIN TIMPs

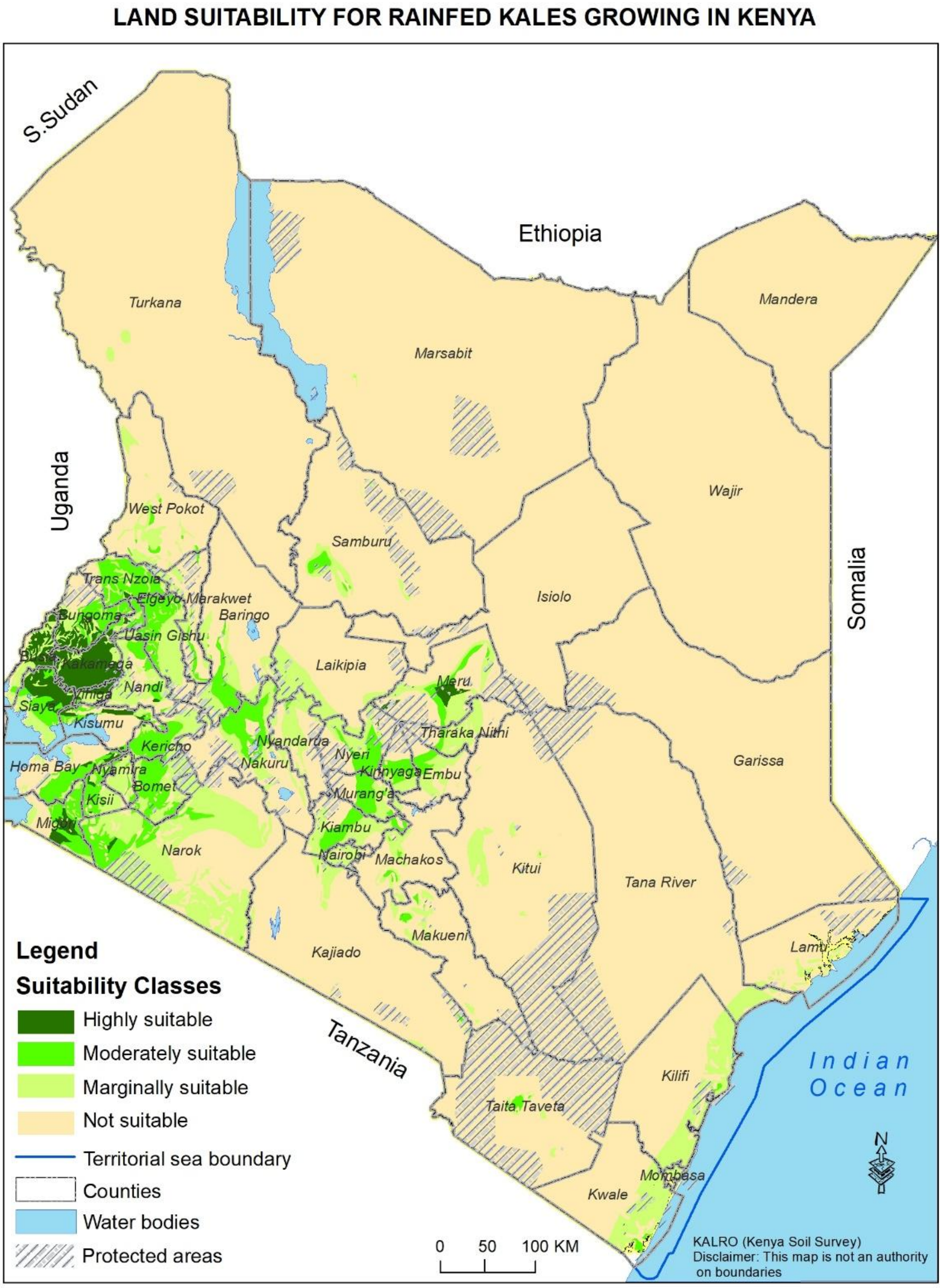

Figure 1 Suitability map for Kale in Kenya

2.1 KALE VARIETIES

2.1.1 TIMP Name	**Collards Southern Georgia**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of superior Kale varieties adapted to warm conditions and tolerance to diseases
What is it? (TIMP description)  Collards Southern Georgia Kale variety	Collard is a popular Kale variety widely adapted to both cold and warm areas. It is drought and heat tolerant. It's tolerant to soft rot and black rot diseases. It matures early within 90 days after transplanting. It's high in vitamin A and C.
Justification	Collard is one of the popular varieties for warm climates with little rainfall or minimal irrigation. It takes short to mature (three months) hence fits within one growing season. It can be harvested several times before the need to plant again. It's tolerant to soft rot and black rot and has a high yield of 15 – 20 T/acre depending on management
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days and Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programmes • Promotional materials (posters/brochures/leaflets, manuals) • Digital platforms • Mobile

Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate the Kale variety • Good seed system involving all stakeholders to ensure seed availability and accessibility • well organized farmer groups and networks • Good Marketing Models and path ways involving all stakeholders • County and central government for policy formulation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to collaborate in research • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central government, (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Trans Nzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Trans Nzoia, Kisumu
Challenges in dissemination	• Lack of a mechanism to facilitate interaction of value chain stakeholders • Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kales • Unorganized marketing channels
Suggestions for addressing the challenges	• Establish Kale innovation platforms • Involve county governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing

Lessons learned in up scaling if any	• Chances of successful upscaling are higher when diverse value chain players collaborate in an innovation platform • Training of agro-dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • Harmonious and collaborative interaction of diverse value chain players in Kale innovation platforms • It is an already "a climate change ready crop" due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 103,850 per acre
Estimated returns	KES 210,000 per acre. Returns =KES 106,1500
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men.

	• 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	
Success stories from previous similar projects	CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in LARI sub- county in Kiambu in 2005
Application guidelines for users	Good agricultural practices, Manuals, Brochures,
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
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Partner organizations	KALRO Kandara, KALRO PTC, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

- Research to release more superior Kales varieties
- Validation and promotion of the variety in the target areas of Kales cultivation

2.1.2 TIMP Name	**Kales variety: Thousand headed**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of superior Kale varieties adapted to warm growing conditions and with long harvesting duration.
What is it? (TIMP description)	Thousand headed Kale variety is popular and widely adapted to warm areas. It is drought and heat tolerant variety with light green leaves and can grow up to 2m long. The variety stem has prolific branching and matures in (60 days with a yield of about 18 - 20 T/ acre depending on management
Justification	Thousand headed is one of the popular varieties for warm climates with little rainfall or minimal irrigation. It takes short time to mature (three months) hence fits within one growing season. It is indeterminate and therefore can be harvested several times before the need to plant again.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.

Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Extension Service Providers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material’s • Mobile
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale varieties • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia

Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kales • Unorganized marketing channels
Suggestions for addressing the challenges	• Involve County governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already “a climate smart ready crop” due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 103,850 per acre
Estimated returns	KES 210,000 per acre. Returns =KES 106,150
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	
Success stories from previous similar projects	CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in LARI sub county in Kiambu in 2005
Application guidelines for users	Brochures, Manuals, Mobile Apps, leaflets
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Officer in Charge, KALRO Practical Training Centre E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org

Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO Kandara, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

- Research to release more superior Kales varieties
- Validation and promotion of the variety in the target areas of Kales cultivation

2.1.3 TIMP Name	Kales variety: Marrow stem
Category (i.e. technology, innovation or management practice)	Technology  Marrow stem Kale variety
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of superior Kale varieties adapted to cooler growing conditions, with little fibre and good digestibility.
What is it? (TIMP description)	Marrow stem is a popular Kale variety adapted to cool areas. It has dark green leaves with low dry matter content. The variety is a tall with a thick stem and large leaves. It can grow up to 2m tall and has and yield of about 17 - 20 T/acre

Justification	Marrow stem is adapted to areas with low temperatures and good distribution of rainfall. It takes short time to mature (three months) hence fits within one growing season. It can be harvested several times before the need to plant again. The leaves have good digestibility and therefore preferred by many consumers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile platforms
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale varieties • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia, Kisumu
Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kale • Unorganized marketing channels
Suggestions for addressing the challenges	• Involve County governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 103,850 per acre
Estimated returns	210,000/Acre Returns = 106,150
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.

Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in LARI sub-county in Kiambu in 2005
Application guidelines for users	Brochures, leaflets, Mobile Apps, Manuals
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director KALRO Seeds; E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org

Lead organization and scientists	Eliezah K., Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO Kandara, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

- Research to release more superior Kales varieties
- Validation and promotion of the variety in the target areas of Kales cultivation

2.1.4 TIMP Name	**Moss curled Kale**
Category (i.e. technology, innovation or management practice)	Technology  Moss curled Kale variety
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of superior Kale varieties adapted to cooler growing conditions, with little fibre and good digestibility.
What is it? (TIMP description)	Moss curled Kale variety is adapted to cool growing areas and matures within three months. The variety has good digestibility and high consumer acceptability. It has large dark green curly leaves. The variety can produce 15 to 20 tons per acre.
Justification	Moss curled Kale is adapted to areas with low temperatures and good distribution of rainfall. It takes short time to mature (three months) hence fits within one growing season. It can be harvested several times before the need to plant again. The leaves have good digestibility and therefore with high consumer acceptability.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Extension Service Providers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials posters/ brochures/ leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale varieties • Mechanism for interaction of Kalen value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia, Kisumu
Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kales • Unorganized marketing channels
Suggestions for addressing the challenges	• Involve County governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 103,850 per acre
Estimated returns	KES 210,000 per acre. Returns =KES 106,150
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.

Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	
Success stories from previous similar projects	CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in Lari sub- county in Kiambu in 2005
Application guidelines for users	Brochures, Manuals, Factsheets
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seed Centre; E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org

Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO Kandara, KALRO Seeds, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

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

2.1.5 TIMP Name	**Mfalme F1 Sukuma wiki**
Category (i.e. technology, innovation or management practice)	Technology  Mfalme F1 sukuma wiki variety
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of high yielding Kale varieties tolerant to insect pests and diseases and with low organic acids in the leaves.
What is it? (TIMP description)	Mfalme F1 is an early maturing variety (45 – 60 days) with long harvesting duration. It is tolerant to Powderly mildew disease, white flies and aphids. The variety can produce 15 to 20 tons per acre.
Justification	Mfalme F1 variety takes short time to mature hence fits within one growing season. It can be harvested several times before the need to plant again. The variety has tolerance to some diseases and insect pests and therefore does not require frequent pesticides application. It is a preferred choice among people with stomach ulcers since its leaves are less acidic.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.

Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days and Agricultural shows • Extension Service Providers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Digital platforms
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate the Kale variety • Collaboration between all partners and stakeholders of Kale value chain stakeholders • Good seed system to ensure quality seed availability and accessibility • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government policy direction
Partners/stakeholders for scaling up and their roles	• Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia, Kisumu
Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kale • Unorganized marketing channels

Suggestions for addressing the challenges	• Involve county governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 103,850 per acre
Estimated returns	KES 210,000 per acre. Returns =KES 106,150
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men.

	• 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials

E: Case studies/profiles of success stories	
Success stories from previous similar projects	CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in LARI sub-county in Kiambu in 2005
Application guidelines for users	Brochures, Manuals, Factsheets, Leaflets, Mobile Apps
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seeds; E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Eliezah K., Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	KALRO Kandara, KALRO Seeds, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

- Research to release more superior Kales varieties
- Validation and promotion of the variety in the target areas of Kales cultivation

2.1.6 TIMP Name	**Ethiopian Kale (Kanzira)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of early maturing Kale varieties with low organic acids in the leaves and are tolerant to insect pests and diseases.
What is it? (TIMP description)	Ethiopian Kale is a cold tolerant variety suitable for cultivation at high attitudes. The variety is

 Ethiopian Kale leaves	early maturing and harvesting starts from 35 days after sowing and continues for up to 10 weeks. Its leaves are though highly perishable are non-acidic and highly palatable. The variety can produce 15 - 20 T/acre depending on level of management. Ethiopian Kale has a niche market among the western and coastal communities in Kenya major towns.
Justification	Ethiopian Kale variety takes a short time to mature hence fits within one growing season. The leaves are less acidic when cooked hence preferred choice among people with stomach ulcers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile

Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale variety • Mechanism for interaction of Kale value chain stakeholders • Good seed system to ensure quality seed availability and accessibility • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government for policy support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations to support research • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Trans Nzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia, Kisumu
Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kales • Unorganized marketing channels

Suggestions for addressing the challenges	• Involve County governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already "a climate smart ready crop" due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES79,850 per acre
Estimated returns	KES 210,000 per acre. Returns =KES 130,150
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	
Success stories from previous similar projects	CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in LARI sub-county in Kiambu in 2005
Application guidelines for users	
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research)	Requires research and validation
G. Contacts	
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Partner organizations	KALRO Marsabit, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

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

2.1.7 TIMP Name	**Kinale**
Category (i.e. technology, innovation or management practice)	Technology  Kinale Kale variety
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low production of Kale due the lack of varieties that can be grown and harvested for long periods (between three to months to three years).
What is it? (TIMP	Kinale is an early maturing variety ready for harvesting 1 month after transplanting. It has wide adaptability ranging

description)	from 1100m – 2500m above sea level. The leaf yield is high ranging from 36 – 98 tons/acre. Kinale variety also produces a lot of seeds.
Justification	Kinale Kale is a nutrient packed and easy to cultivate vegetable even in small kitchen gardens. Majority of stakeholders and farmers are not aware of the new high yielding kinale variety. Kinale variety can be harvested for long period before the need to plant again.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale varieties • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders • Adequate facilitation

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination
	• NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia, Kisumu
Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kales • Unorganized marketing channels
Suggestions for addressing the challenges	• Involve County governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already “a climate smart ready crop” due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	KES 180,850 per acre
Estimated returns	KES 504,000 per acre. Returns =KES 323,150
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in Lari sub-county in Kiambu in 2005

Application guidelines for users	Manuals, Factsheets, Brochures, leaflets
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seeds Centre; E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF, Agricultural University Colleges

Research Gaps

1. Research to release more superior Kales varieties

- Validation and promotion of the variety in the target areas of Kales cultivation

2.1.8 TIMP Name	**Tosha**
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 Kale due the lack of varieties that can be grown and be harvested for long periods between 3 months to 3 years.

What is it? (TIMP description)	Tosha is an early maturing variety ready for harvesting 1 month after transplanting. It has wide adaptability ranging from 1100m – 2500m above sea level. The leaf yield is high ranging from 47 – 87 tons/ acre. The variety has a harvesting period of up to 3 years.
Justification	Kale is a nutrient packed and easy to cultivate vegetable even in small kitchen gardens. Majority of stakeholders and farmers are not aware of the new high yielding bean varieties. Tosha variety can be harvested for long period before the need to plant again.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale varieties • Mechanism for interaction of Kalen value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders □ Adequate facilitation

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu and Tranzoia, Kisumu
Challenges in dissemination	• Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices • High perishability of Kale • Unorganized marketing channels
Suggestions for addressing the challenges	• Involve County governments, extension and stockists in seed distribution • Engagement of wider range of stakeholders • Information dissemination on production practices • Promotion of the variety in the suitable areas • Promote value addition and consumption in local food systems • Promote marketing models that encourage collective production and marketing
Lessons learned in up scaling if any	• Training of agro dealers necessary • Farmers participatory approach works
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on the nutritional benefits of the variety. • It is an already "a climate change ready crop" due to its wide adaptation ability. • Organized marketing channels critical for benefits to be derived from the technology • Enabling policy and policy review from time to time

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 106,980 per acre
Estimated returns	KES 658,000 per acre. Returns = KES 551,020
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women have limited access to markets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the reguired credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired credit. • Increased production will lead to increased consumption and utilization of Kales and hence improved health of VMGs. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
E: Case studies/profiles of success stories	

Success stories from previous similar projects	CABI & KALRO were able to develop 2 varieties from high yielding & pest/disease resistant landraces found in Lari sub-county in Kiambu in 2005
Application guidelines for users	Brochures, Factsheets, Manuals and mobile Apps
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director; KALRO Sedd Centre; E-mail: info.ptc@kalro.org The Centre director, KALRO- Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges

Research Gaps

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

2.2 KALES SEED SYSTEMS

<table>
<tr><td>2.2.1. TIMP Name</td><td>Kale informal seed system</td></tr>
<tr><td>Category (i.e. technology, innovation or management practice)</td><td>Innovation

Informal seed production, flower buds are covered with muslin cloth to prevent pollen contamination</td></tr>
<tr><td colspan="2">A: Description of the technology, innovation or management practice</td></tr>
<tr><td>Problem to be addressed

Informal seed produced for sale without cleaning</td><td>Kale seed systems are not well established and this has hindered promotion of the crop to the target areas. Promotion of Kales to farmers in the various counties requires enough seed to reach the targeted number of farmers. The weak Kale formal seed system has not been able to achieve the quantities of the seed which are required. The seeds produced using informal systems is usually of poor quality. In order to reach more farmers with the available Kales varieties, there is need to train farmers on informal seed system which will involve community seed bulking.</td></tr>
</table>

What is it? (TIMP description)  Heavy seed producing kinale variety	An informal seed system is a community seed bulking which is a process of engaging selected individuals or farmer groups to multiply. Kale seeds are produced under technical supervision following seed multiplication guidelines. Under the informal seed system, the seed production site should be relatively free from diseases and pests. The seed bulking plot should be in a separate farm to avoid genetic mixture. Kale requires lower temperatures for longer days for flower initiation and therefore the flowering should be timed to take place during the cold season. Off types and crop volunteers should be uprooted. At flower initiation the flower buds are covered with paper envelop to prevent pollen contamination from another nearby varieties. The bagged flower buds should then be pollinated artificially during flowering with pollens collected from the same variety.
Justification	Seed production at the farm level by farmer is still the most common source of seeds for Kale farmers. Inadequate knowledge in appropriate Kale seed production practices such as maintenance of isolation distance, maintenance of genetic purity, disease management leads to genetic contamination and low yields. Famers require capacity building on seed production to improve seed quality and to reduce transmission of diseases through seeds. The seed multiplied can be used in promotion of Kale varieties through recruitment of more farmer groups and in that way create more awareness.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings, Field days, Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/ leaflets, manuals) • Digital media
Critical/essential factors for	• Development of good seed systems to backstop own

successful promotion	• seed selection • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii and Kericho
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii and Kericho
Challenges in dissemination	• Low use of seed selection methods • Lack of knowledge on seed cleaning and packaging • Unwillingness of farmers to buy quality seeds • Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices
Suggestions for addressing the challenges	• Train farmers on seed selection and empower their ability to access seed • Research to develop high yielding superior varieties with quality seed • Information dissemination on importance of using good seed to increase yield • Involve County governments, extension, agro- vets and seed companies

<table>
<tr><td>Lessons learned in up scaling if any</td><td>Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations
Availability of market is key</td></tr>
<tr><td>Social, environmental, policy and market conditions necessary for development and up scaling</td><td>Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities.
Harmonious gender and social consideration in research, consumption and marketing.
It is an already “a climate smart ready crop” due to its wide adaptation ability. .
Enabling policy and policy review from time to time</td></tr>
<tr><td colspan="2">D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</td></tr>
<tr><td>Basic costs</td><td>Depends on the variety</td></tr>
<tr><td>Estimated returns</td><td>Depends on the variety</td></tr>
<tr><td>Gender issues and concerns in development, dissemination, adoption and scaling up</td><td>Women and youth have limited access to land for Kale seed multiplication than men.
Women have less access to agricultural information, technology and knowledge than men.
Women and youth have limited access to education, training and extension services than men.</td></tr>
<tr><td>Gender related opportunities</td><td>Affirmative action opportunities exist for women and youths to credit to rent land for seed multiplication.</td></tr>
<tr><td>VMG issues and concerns in development, dissemination, adoption and scaling up</td><td>VMGs have limited access to land for Kale seed multiplication than men.
VMGs have less access to agricultural information, technology and knowledge than men.
High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMGs have limited access to education, training and extension services than men.
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.</td></tr>
<tr><td>VMG related opportunities</td><td>Affirmative action opportunities exist for VMGs to acquire credit to rent land for seed multiplication.</td></tr>
<tr><td colspan="2">E: Case studies/profiles of success stories</td></tr>
</table>

Success stories from previous similar projects	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	Manuals, Brochures, Factshets, Leaflets and Mobile Apps
F: Status of TIMP readiness (1ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Officer in Charge, KALRO Practical Training Centre E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	CABI, MoALF, Agricultural University Colleges, IFPRI.

Research Gaps

- The Kale seed system is very weak. A newly released variety will not be taken up easily by the formal and informal seed system for seed multiplication. There is need to establish an alternate seed production and supply system.
- There is disconnect between research and the end users on the type of varieties needed in the target areas. The solution will be working with stakeholders in technology development.

2.2.2. TIMP Name	**Use of stem cuttings in propagation of Kale**
Category (i.e.technology, innovation or management practice)	Innovation   Kale plants with many ready stems as propagation materials
A: Description of the technology, innovation or management practice	

<table>
<tr><td>Problem to be addressed</td><td>Kale production and productivity in Kenya is still low due to several factors among them is use of poor quality planting materials. Usually, farmers are not willing to buy new seed stock every planting season due to shortage of cash. Consequently, farmers continue to use planting materials obtained from previous crops. The quality of this planting material is often poor which includes kale stem cuttings. This is due to the bad practices at all stages of production and selection resulting in low yields in subsequent season.</td></tr>
<tr><td>What is it? (TIMP description)

</td><td>Vegetative propagation is multiplication or reproduction of plants using the vegetative parts such as stem cutting. Cuttings are detached vegetative parts of a plant which on planting are able to regenerate into a new plants. Vibrant, high yielding disease and pest free plants are selected in the field as mother stock. The terminal shoot is nipped to allow production of many lateral shoots. The lateral shoots are allowed to grow to a length of 10-20cm. A slant cut is given just near the base of the shoot using a clean knife. The cuttings are kept on moist cloth under shade awaiting planting. Dipping the base of the cutting in fungicide solution before planting reduce infection. The cuttings are planted in slanting position so that their maximum base is in contact with soil. The soil should be kept moist to ensure quick development of roots.</td></tr>
<tr><td>Justification</td><td>Vegetative propagation through cuttings can be used to maintain genetic purity of preferred varieties in subsequent crops. The plants raised from cuttings and suckers will reach maturity earlier than those raised from seeds. It’s an inexpensive and quick method of propagation. A large number of uniform plants can be produced from one parent.</td></tr>
<tr><td colspan="2">B: Assessment of dissemination and scaling up/out approaches</td></tr>
<tr><td>Users of TIMP</td><td>Farmers, Seed dealers, Researchers, Extension service.</td></tr>
</table>

Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale varieties • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii and Kericho
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii and Kericho

Challenges in dissemination	• Low use of seed selection methods • Unwillingness of farmers to buy quality seeds • Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices
Suggestions for addressing the challenges	• Train farmers on seed selection and empower their ability to access seed • Research to develop high yielding superior varieties with quality seed • Information dissemination on importance of using good seed to increase yield • Involve County governments, extension, agro vets and seed companies
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • It is an already "a climate change smart crop" due to its wide adaptation ability. • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on the variety
Estimated returns	Depends on the variety
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale propagation than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to credit to purchase the required inputs.
Gender related opportunities	Affirmative action opportunities exist for women to acqure the required credit.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale propagation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials. • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire the reguired.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale propagation than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to credit to purchase the required inputs.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Officer in Charge, KALRO Practical Training Centre E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org

Lead organization and scientists	Eliezah K., Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	CABI, MoALF, Agricultural University Colleges, IFPRI.

2.2.3. TIMP Name	**Kales formal seed system**
Category (i.e. technology, innovation or management practice)	Innovation 
A: Description of the technology, innovation or management practice	
Problem to be addressed	New crop varieties developed through formal breeding systems address local agro-ecological conditions, pest problems and have higher yield potential. The formal seed system ensures high quality seed. However, only few farmers have adopted the new improved varieties due to lack of awareness of the benefits of planting high quality improved certified seeds.
What is it? (TIMP description)	Formal seed system is the process of producing seed starting from release of varieties, production of early generation seed, and certified seed up to the stage where the farmers can access it through seed merchants for planting. The main stakeholders in formal seed systems include breeders, seed companies and retailers among others. The formal seed system starts with plant breeding and promotes material for formal variety release and maintenance. Regulation exists in this system to maintain variety identity and purity as well as to regulate physical and sanitary quality. Seed marketing takes place through registered seed outlets and through national agricultural research system. Farmers can be contracted by the seed companies to carry out seeds bulking for those companies though under the supervision of KEPHIS. In Kenya, more than 8 Kale varieties have formal seed system.
Justification	Formal seed system provides high quality, genetically pure and high yielding seeds. Certified seeds have high germination, vigor and are disease free thereby contributing to high yields and returns of Kale farming. By creating farmers awareness on formal seed system, they will be better prepared to take advantage of opportunities to engage in seed production as an income generating activity within formal seed system. The understanding of farmers on the

	benefits of using certified seeds may also increase the uptake of new crop varieties.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, seed companies, Seed dealers, Researchers, Extension service.
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Digital media
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale seed for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale varieties • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce
	• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyandarua, Kiambu, Nyeri, Kisii and Kericho

Counties where TIMP will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii and Kericho
Challenges in dissemination	• Unwillingness of farmers to buy quality seeds • Poor distribution of quality seed • Wide scope of production areas • Low use of agronomic practices
Suggestions for addressing the challenges	• Train farmers on their ability to access seed • Research to develop high yielding superior varieties with superior qualities • Information dissemination on importance of using good seed to increase yield • Involve County governments, extension, agrovets and seed companies
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on nutritional and livestock importance of the varieties in consideration to the social cultural set up of the target communities. • Harmonious gender and social consideration in research, consumption and marketing. • It is an already "a climate smart ready crop" due to its wide adaptation ability. . • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Depends on the variety
Estimated returns	Depends on the variety
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale seed multiplication than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to credit to rent land for seed multiplication.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for Kale seed multiplication than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials. • VMGs have limited access to education, training and extension services than men. • 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	• Affirmative action opportunities exist for VMGs to acquire credit to rent land for seed multiplication.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	1. CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	Brochures, Manuals, Factsheets, Leaflets
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for upscaling
G. Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director; KALRO Seeds; E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	CABI, MoALF , Agricultural University Colleges, IFPRI.

Research Gaps

1. There is disconnect between research and the end users on the type of varieties needed in the target areas. The solution will be working with stakeholders in technology development.

2.3. GOOD AGRICULTURAL PRACTICES (GAPs) AND FOOD SAFETY MANAGEMENT SYSTEMS

2.3.1. TIMPs name	**Good Agricultural Practices (GAP) for Kale**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Detection of food contaminants in fresh produce, including Kale, has been rampant. This results in declining food safety and quality, therefore frustrating sustainable farming of these crops for both food and income generation. These contaminants also impact negatively on the environment, worker safety and health, and consequently making it difficult to implement traceability as most producers do not give accurate information to avoid commercial losses and even prosecution
What is it? (TIMP description)	It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards. It is not about a specific crop production but the process through which production takes. The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. Commercialization of Kale highly depends on compliance to these market standards
Justification	There is need to arrest the rampant detection of food contaminants in the fresh produce such as Kale. Good Agricultural Practice (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture [by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM)] to continuously improve farming systems. GAP is of utmost importance in protecting consumer health by ensuring safety throughout the food chain. It needs to be enforced and transparent not only from the table but also upstream to include suppliers (e.g. quality of fertilizers and plant protection products) and all the value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	All Kale value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate

	handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets and larger plot demonstrations.
Critical/essential factors for successful promotion	Policy government support and training of all stakeholders
Partners/stakeholders for scaling up and their roles	Producer organizations, NGO's, MoA, Private extension providers, Competent authorities, Council of Governors and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	None
Counties where TIMP will be up scaled	Marsabit and all counties in Kenya where Kale is produced and consumed
Challenges in dissemination	• Lack/inadequate knowledge on the benefits GAPs • Lack of legislative mechanisms to support the GAP, in particular the domestic scope • The perception that GAP is oppressive rather than supportive • The low number of stakeholders aware of GAP
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	None
Social, environmental, policy and market conditions necessary	• Supportive policy of national and county governments to promote adaption of GAP's • Promotion of sustainable IPM practices for crop health problems • Training of all stakeholders on benefits of GAP • Implementation of KS1758, the local GAP
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge on GAP than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean health kales that are free from hazards.

VMG issues and concerns in development, dissemination, adoption and scaling up	• Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	• Proper application of GAP will led to improved health of the various gender categories due to consumption of clean health kales that are free from hazards.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge on GAP than men. • Women have less access to agricultural information, technology and knowledge than men.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	• Options for certification exist depending on weather it is a single holder certification or group compliance. • Compliance is a process and hence takes time and involves a process of continuous improvement. • No need for farm sophistication to adopt. • There is provision for taking corrective action for all noncompliance at time of assessment. • Requires continuous training and exposure to better systems.
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	• The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org • Director, KALRO Seeds; E-mail: info.ptc@kalro.org • The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org, • The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org, • The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	KALRO: Nyaga A., Ndung'u, J., Wayua, F., Gatambia E., Wasilwa, L and Kirigua, V.
Partner organizations and their roles	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, County governments, NGO's and Universities.

2.3.2. TIMP Name	**Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Kale Value Chain in Kenya**

Category(i.e. technology, Innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	The presence of chemical, biological and physical hazards within the Kale value chain in Kenya have a direct effect on consumer's health. There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of *Escherichia coli* (E. coli), *Salmonella* spp., *Aspergillus flavus* and *Aspergillus parasiticus*. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects.
What is it? (TIMP description)	Food safety management system (FSMS) through Hazard Analysis and Critical Control Point (HACCP) in Kale value chain is a system of food safety monitoring and control based on the systematic identification and assessment of various hazards. It is a preventive, rather than a reactive, tool that places the protection of the Kale supply from biological, chemical and physical hazards into the hands of food management systems. The system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls.
Justification	There is increasing demand for high quality of the crop and other products where it is incorporated, from consumers and public health departments in counties. The biological contaminations previously reported on this value chain include presence of Escherichia coli (E. coli), Salmonella spp., Aspergillus flavus and Aspergillus parasiticus. The chemical hazards are mainly due to heavy metal presence such as lead/mercury/cadmium; while exceedance of MRLs been reported. These hazards are suspected to cause neurological disorders, cancer and birth defects. There is need to put in place risk analysis and hazard monitoring and management system to ensure that food contaminants are kept at bay along the Kale value chain. Presence of these contaminants not only poses serious risks to human health and trade. Such tools are used globally and even adapted by Codex Alimentarius as a global acceptable FSMS. 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 as required. Parameters will be quantified for production, harvesting, processing, distribution and value addition
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Kale value chain actors from farmers, traders, food vendors and consumers.
Approaches used in dissemination	• Training of stakeholders on GAP, Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP) • Kale innovation platforms • FFBS sessions • Through common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).
Critical/essential factors for successful promotion	• Formation of "experts" team composed of HACCP specialists, food scientists, microbiologists, representative of the Kale (and other similar crops) value chain players, public health officers, and a quality control and safety specialists from the competent authorities to guide the process • Local and National governments support
Partners/stakeholders for scaling up and their respective roles.	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players • Farmers/farmer groups • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • National competent authorities • Analytical testing services • 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	• All counties growing and consuming Kale in Kenya.
Challenges in development and dissemination	• Inadequate funds to reach value chain actors • New concept not very well known among the primary stakeholders and market outlets
Suggestions for addressing the challenges	• Funding of dissemination platforms • Training of all stakeholders on food safety
Lessons learned in up scaling, if any	• None since scaling up has not been done
Social, environmental, policy and market conditions necessary for development and up-scaling	• Kale being observed by stakeholders as a food and commercial crop that requires protection from contamination • Use of less toxic crop protection methods in handling crop health issues • Establishment of practical and acceptable food handling protocols at both county and National levels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	To be determined
Estimated returns	To be determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to agricultural information, technology and knowledge on HACCP than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean health kales that are free from hazards.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	• Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean health kales that are free from hazards.
○ **E: Case studies/profiles of success stories**	
Success stories	N/A
Application guidelines for users	N/A
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3 . Requires further research)	Ready for up scaling;
○ **G: Contacts**	
Contacts	The Institute Director, FCRI Njoro; Email director.fcrinjoro@kalro.org The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seeds, E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	2. 1. Mr. John N. Ndung'u, FCRI - KALRO Njoro 3. Antony Nyaga, KALRO Seeds Thika 4. Dr. Francis Wayua, KALRO Kakamega 5. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters 6. Mrs. Violet Kirigua, KALRO Headquarters 7. Beatrice Wanjiku, KALRO Njoro
Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, KEBS, County governments, NGO's and Universities.

2.4 GOOD AGRONOMIC PRACTICES OF KALE

2.4.1. TIMP Name	**Raised, flat and sunken nursery beds**
Category (i.e. technology, innovation or management practice)	Technology    Sunken beds Raised beds Flat beds
A: Description of the technology, innovation or management practice	
Problem to be addressed	The technology addresses the poor germination of kale seeds. It also addresses losses caused by adverse weather conditions like flooding and dry weather conditions.
What is it? (TIMP description)	The raised beds nurseries are for high rainfall areas where seed planting area is elevated by 20 to 30cm above ground to allowing the drainage of excess water from the bed. Flat beds nursery are meant for areas with moderate rainfall aimed at conserving moisture where the seeding area is raised by 10cm above ground. Sunken beds on the other hand are meant for arid and semi-arid areas with minimum rainfall and helps in moisture conservation.
Justification	Inappropriate Kale seed nurseries beds have resulted in poor germination and disease infestation at this stage. Farmers need suitable nursery beds for different ecological zones taking advantage of the conditions and resulting in healthy kale seedlings.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Seed dealers, Researchers, Extension service providers and Market players
Approaches used in dissemination	• On farm trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Extension service providers • Farmer research networks • Lead farmers and farmer groups • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Farmers/Farmer groups and networks • County and National government support • Seed availability and accessibility through Kale research • Functional extension service • Kale crop treated as a commercial crop

Partners/stakeholders for scaling up and their roles	• Seed companies for quality planting material • Market players • Farmers/farmer groups to adopt and produce • KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide varieties, seed and production information • County governments, National government e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to organize and mobilize farmer groups and assist them acquire have community nurseries • 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	Machakos, Kitui, Embu, Meru, Kisii, Migori, Kirinyaga and all other counties where Kale is grown
Counties where TIMP will be up scaled	Kiambu, Nyandarua, Nyeri, Kisii, Kerich, Taita Taveta, Bungoma, Nakuru, Elgyo Marakwet, Narok, Machakos, Kitui and other Kale growing counties
Challenges in dissemination	• Lack of quality seed due to own unregulated seed production • Lack of knowledge on seed selection methods • Unwillingness of farmers to buy quality seed • Low awareness of importance nutritional of kales in most parts of Kenya • Kale considered as a poor man’s crop other than a commercial crop
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties with quality seed • Information dissemination • Train farmers on Good nursery management practices and the need to use certified/quality seeds • Develop good policy for the kale to enhance seed marketability • Involve County governments, extension, marketers and processors
Lessons learned in up scaling if any	• The creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Demonstration of varietal potential is best adapted after observation by farmers in FFBS or other field demonstration fora.
Social, environmental, policy and market conditions necessary for development and up scaling	• Commercial and nutritional benefits of Kale enhance the demand for the technologies and hasten their uptake process • Kale is an already “a climate smart ready crop” due to its wide adaptation ability

	• Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 50,000
Estimated returns	KES 80,000
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for kale cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as seeds than men. • Women and youth may have less access to labour than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• Employment opportunities for youth males and men exists in the raised nursery preparation. • Opportunity exist for women to access the the required credit through the women entererprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs may also have limited access to finances to buy the required inputs such as seeds and equipment than men. • VMGs have less access to agricultural information, technology and knowledge than men • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Increased production will lead to increased consumption and utilization of kale and hence improved health of VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar project	CABI & KALRO were able to select and release 2 high yielding & Pest/disease resistant varieties in 2010.
Application guidelines for users	
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research	Ready for Validation
Research	
G. Contacts	

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Lead organization and scientists	Antony N., Eliezah K., Eliud G.,.Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.2. TIMP Name	**Seed Trays for clean planting materials**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	The technology addresses the poor germination of kale seeds, loss of seeds particularly at watering and .ease of maintenance of suitable nursery conditions. It also addresses losses caused by adverse weather conditions like flooding, dry weather conditions.
What is it? (TIMP description)	These are plastic trays with small holes where media is put and kales seeds are sown. The seedlings are supplied with nutrients and water until they are ready for transplanting. The trays reduces the transplanting shock and are easy to transport. They are cost effective as they can be reused many times.
Justification	Clean planting materials are important for higher yields and good returns. The use of trays ensures good germination, healthy plants as they are easy to control and manage under trays. It is possible to use little media in the small cups hence saving costs. Management and transportation of seedlings after germination is easy convenient.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Seed dealers, Researchers, Extension service providers
Approaches used in dissemination	• On farm trials and demonstrations • Training workshops, Seminars, Meetings • Field days/exhibitions/shows • Extension service providers • Farmer research networks • Lead farmers and farmer groups • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Practicing farmers, farmer groups and networks • Vegetable nursery operators • County and central government support • Seed availability and accessibility through Kale research • Functional extension services
Partners/stakeholders for scaling up and their roles	• Farmers/farmer groups to adopt Seed Trays nurseries for clean planting materials • Market players to create awareness for seedlings trays. • International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide Kale seed tray for clean planting materials. • NGOs to organize and mobilize farmer groups and assist them acquire seed trays. • 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	Machakos, Kitui, Embu, Meru, Kisii, Migori, Kirinyaga and all other counties where Kale is grown
Counties where TIMP will be up scaled	Kiambu, Nyandarwa, Nyeri, Kisii, Kericho, Taita, Taveta, Bungoma, Nakuru, Elgyo Marakwet, Narok, Machakos, Kitui and other counties where Kale is grown
Challenges in dissemination	• Low awareness of importance of clean seedlings in most parts of Kenya • Lack of quality seed due to farmers producing own seed • Low use of trays as way of raising seedlings • Unwillingness of farmers to buy quality seed
Suggestions for addressing the challenges	• Research to develop high yielding superior varieties with quality seed • Information dissemination on importance of using plastic trays to have quality planting materials. • Train farmers on seed nursery management and empower their ability to access plastic trays • Develop good policy for the kales • Involve County governments, extension, marketers and processors

Lessons learned in up scaling if any	Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations
Social, environmental, policy and market conditions necessary for development and up scaling	• Create awareness of the benefits of using seedlings trays in most parts of Kenya • Capacity building of all players in the kale value chain (including Women, Men and youth • It is an already "a climate smart ready crop" due to its wide adaptation ability. . • Enabling policy and policy review from time to time
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5000 - per/acre (For materials to produce seedlings for 1 acre)
Estimated returns	KES 39,000 per acre
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as fertilizers than men. • Women and youth may have less access to credit than men • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Opportunity exist for women to access credit through the women entererprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs may also have limited access to finances to buy the required inputs such as seeds and equipment than men. • VMGs have less access to agricultural information, technology and knowledge than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar project	CABI & KALRO were able to select and release 2 high yielding & Pest/disease resistant varieties in 2010.
Application guidelines for users	Manuals, Factsheets, Leaflets, Mobile Apps
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research Research	Ready for Upscaling
G. Contacts	

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Lead organization and scientists	Antony N., Eliezah K.,Eliud G., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.3. TIMP Name	**Exclusion nets for nurseries pest and disease control**
Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	Damage to seedlings at nursery level is common from pests and diseases. Use of exclusion nets provides a non-pesticide control method through denying the pests access to the plant by forming a barrier.
What is it? (TIMP description)	Pest-exclusion nets create a barrier that protects the seedlings against pests and associated diseases. The nursery beds are covered with an exclusion net that in addition also protect the seedlings from environmental hazards and small animals The nets are easy to use and can also serve as floating row covers to control temperature, light, relative humidity and soil moisture for plant production. The nets are low-cost and can be reused for 3–5 years
Justification	Farmers have been producing planting materials in open nurseries where kale seedlings are exposed to pests, disease, strong winds and sometimes torrential rains. Farmers needs to be sensitized on the use of cheap alternatives such as exclusion nets for production of quality planting materials
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Nursery operators, Seed dealers, Researchers, Extension service

	providers.
Approaches used in dissemination	• On farm trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Extension service providers • Farmer research networks • Lead farmers and farmer groups • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Vegetable seedlings nursery operators • Manufacturers of cheap nets • County and central government support • Seed availability and accessibility through research • Strong Extension service Development of good seed systems to backstop Exclusion net nurseries
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide varieties, seed and production information • Seed companies for quality seed multiplication • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs to organize and mobilize farmer groups and assist them acquire seed and exclusion nets. • 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	Kiambu, Machakos, Muranga, Embu, Kirinyaga among others
Counties where TIMP will be up scaled	Kiambu, Nyandarwa, Nyeri, Kisii, Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet, Narok, Machakos, Kitui and other Kale growing counties
Challenges in dissemination	• Limited awareness of the functionality of exclusion net nurseries in most parts of Kenya • Lack of quality seed due to farmers producing own seed • Low use of exclusion net nursery as way of raising seedlings • Unwillingness of farmers to buy quality seed and exclusion
Suggestions for addressing the challenges	• Information dissemination on benefits of using exclusion nets for nurseries • Incorporation of systems to clean/improve farmers own seed Research to develop high yielding superior varieties with quality seed • Train farmers on seed production and enhance their ability to access clean seed • Develop good policy for the production of high quality

	seedlings • Involve County governments, extension, marketers and processors
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of markets for both seedlings and produce is paramount
Social, environmental, policy and market conditions necessary for development and up scaling	• Promotion of cultivation of Kale as a cash crop • It is an already "a climate smart ready crop" due to its wide adaptation • Enabling policy and policy review from time to time • Research input in the development of additional TIMPs for Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 20,000
Estimated returns	KES 50,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men. • Women and youth may also have limited access to finances to buy the required inputs such as nets than men. • Women have less access to agricultural information, technology and knowledge than men. • Women have less access to education, training and extension.
Gender related opportunities	• Opportunity exist for women to access credit through the women entererprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs may also have limited access to finances to buy the required inputs such as seeds and equipment than men. • VMGs have less access to agricultural information, technology and knowledge than men. • Women have less access to education, training and extension. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs.
E: Case studies/profiles of success stories	
Success stories from previous similar project	CABI & KALRO were able to select and release 2 high yielding & Pest/disease resistant varieties in 2010.
Application guidelines for users	Exclusion can be used for both nurseries and even in the production fields where they are beneficial to the plants.
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research Research	Require validation
G. Contacts	

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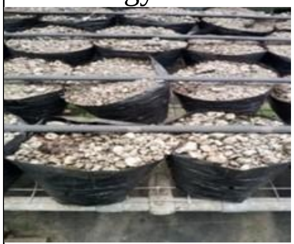
Lead organization and scientists	Antony N., Eliezah K.,Eliud G., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.4. TIMP Name	**High Health soilless Nursery**
Category (i.e. technology, innovation or management practice)	Technology    Pumice, Vermiculite, Cocopit and others (Non soil Media)
A: Description of the technology, innovation or management practice	
Problem to be addressed	The technology addresses the problem of contamination of Kale planting materials form soil pests, diseases and other chemical and biological contaminants contained in the soil media.
What is it? (TIMP description)	The use of soil less media gives assurance of high health to the resultant seedlings. High health nursery is where seedlings are raised in containers placed away from the soil and contain soilless media. Seeds are placed in this media and provided with all other nutritional and water requirements necessary for germination. When the seedlings achieve the desired growth, they are ready for transplanting in the field and are free from any soil borne contaminants.
Justification	Farmers have been producing planting materials in open nurseries where kale seedlings are exposed to pests, disease, strong winds and sometimes torrential rains. Farmers needs to be sensitized on the use of high health nursery for production of quality kale planting materials. These nurseries are able to produce a lot of seedlings in small spaces
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Seed dealers, Researchers, Extension service.

Approaches used in dissemination	• On farm trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Extension service providers • Farmer research networks • Lead farmers and farmer groups • Promotional materials (posters/brochures/leaflets, manuals) • Web material's
Critical/essential factors for successful promotion	• Vegetable nursery operators • Kale farmers • County and National government support • Certified Kale seed availability • Development of good seed systems to backstop High health nurseries
Partners/stakeholders for scaling up and their roles	• Farmers/farmer groups to adopt High health nurseries for clean planting materials • Extension service providers • Market players to create awareness for seedlings High health nurseries • International research organizations e.g. The International Food Policy Research Institute (IFPRI), to provide Kale seed High health nurseries for clean planting materials • NGOs to organize and mobilize farmer groups and assist them acquire High health nurseries • 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	Kirinyaga, Transnzoia, Uasingishu, Nakuru and Kiambu
Counties where TIMP will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui and other counties where Kale is being grown
Challenges in dissemination	• Low awareness on high health nurseries in most parts of Kenya and the benefits • Unavailability of Non soil media in most localities in Kenya • Additional cost implications when using Non soil media • Lack of quality seed due to farmers producing own seed • Unwillingness of farmers to buy quality seed and High health nurseries
Suggestions for addressing the challenges	• Capacity building and information dissemination on benefits of using High health nurseries as a way of high quality seedlings • Research input to develop high yielding superior varieties with quality seed • Train farmers on seed production and empower their ability to access High health nurseries • Develop good policy for the production of high quality

	seedlings • Involve County & National governments, extension, marketers and processors
Lessons learned in up scaling if any	• Creation of awareness through demonstrations and farmer workshops helps in adoption of technologies and innovations • Availability of market is key to adoption of High health nurseries
Social, environmental, policy and market conditions necessary for development and up scaling	• Promotion of cultivation of Kale as a cash crop • It is an already "a climate smart ready crop" due to its wide adaptation • Enabling policy and policy review from time to time • Research input in the development of additional TIMPs for Kale • Commercialization of clean Kale seedlings
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 60,000
Estimated returns	KES 80,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to land for Kale cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as fertilizers than men. • Women and youth may have less access to credit than men • The technology may not be adopted if the gender targeted is women who are especially overburdened • Women may not have time and mobility to attend extension activities far from home or held at times when they are performing other roles e.g. domestic • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	• All gender categories can participate in growing Kale varieties • Use of the farmer field and business school strategy for effective training of farmer groups on Kales production and marketing • The relatively steady stream of income from Kale production over a long period contributes to economic empowerment and alleviation of financial problems of the various gender categories (women, men, youth etc.). • Cash generated from Kale production by the various gender categories can be ploughed back in other agricultural enterprises such as other crops or livestock farming. • Opportunities for youths and women exists in Kale production , and marketing

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to markets • VMGs have limited access to land for Kale cultivation than men • VMGs may have less access to credit • VMGs may also have limited access to finances to buy the required inputs such as seeds than men • Women have less access to agricultural information, technology and knowledge than men • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production will lead to increased consumption and utilization of Kales hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar project	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	Brochures, Manuals, Mobile Apps, leaflets, factsheets
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research Research	Ready for upscaling
G. Contacts	
Contacts	Director, KALRO Seeds, E-mail: info.ptc@kalro.org The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Antony N., Eliezah K., Eliud G., Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.5 TIMP Name	Land preparation
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low yields and poor Kale quality as a result of poor crop establishment caused by Improper land preparation
What is it (TIMP description)  Use of ox plough in land preparation	Land preparation is setting the farmlands for seed planting. Land is ploughed during dry spells to allow for aeration and expose soil borne pests to die. Soil clods should be broken to fine tilth. In conventional land preparation, hoe, oxen and tractor are used for opening the soil and breaking the clods to fine tilth. The soil is usually opened to a depth of 30cm. The farms are ploughed at least 3 times to give very fine tilth before direct sowing. In conservation agriculture, there is minimum soil disturbance during the land preparation to conserve soil moisture and soil biodiversity.
Justification	A well-prepared field is also called a seed-bed and planting area bed allows for good plant establishment including germination, emergence and growth. Properly prepared land ensures increased water infiltration and prevents competition from weeds that results in significant yield loses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension services agencies, Researchers, NGO's,
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Extension service providers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile platforms
Critical/essential factors for successful promotion	• Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and National government support • Funding to research, validate and promote new Kale TIMPs • Collaboration between all partners and

	stakeholders
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, National governments e.g. Chiefs, Agricultural • Extension (Formal and informal) service providers • Policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Most counties in the medium to high rainfall Areas
Counties where TIMPs will be up-scaled	All counties where KALE is being grown
Challenges in dissemination	• Labour intensive (hence costly) for small holder farmers • Farmers may modify the recommendation due to current practices
Suggestion for addressing the challenges	• Promotion of ox ploughs through support by the county governments • Reviewing/adjusting recommendation but still ensuring minimal land disturbance for moisture conservation after planting
Lessons learned In up scaling	Correct land preparation ensures good germination, plant establishment, proper weed control, moisture conservation and enhances yields
Social, environmental, policy and market conditions necessary for development and scaling	• Kales is socially acceptable country wide and any technology to increase its production will be readily adopted • Awareness of the benefits/advantages/management of the technology to enhance acceptability for increased up take. • Existence of suitable bio-physical environments in target counties.

	•Availability of commodity market.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for land preparation. The cost will depend on the land size, labor costs and the landscape terrain. However basic cost ranges from KES 8,000 to 10,000 per acre.
Estimated returns	Unknown but contribute towards increased yield along with other agronomical practices jointly.
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Men perform most of the land preparation tasks therefore the TIMP may not be adopted if they are engaged in other activities. • Women may have less access to credit to purchase the required implements.
Gender related opportunities	• Opportunity exist for women to access credit through the women entererprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to credit to purchase the required implements. • VMGs have less access to agricultural information, technology and knowledge than men. • Women have less access to education, training and extension. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
VMG related opportunities	• Opportunity exist for women to access credit through the women entererprise funds.
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Men perform most of the land preparation tasks therefore the TIMP may not be adopted if they are engaged in other activities. • Women may have less access to credit to purchase the required implements.
E: Case studies/profiles of success stories	
Success stories from previous similar project	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	The Management practice can be used for both nurseries and production fields where they are beneficial to the plants.
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further	Ready for upscaling

research Research	
G: Contacts	
Contacts	Director; KALRO Seeds, E-mail: info.ptc@kalro.org The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Antony N. Eliezah K.,Eliud G., , Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.6 TIMP Name	**Recommended Kale plant spacing in the field**
Category (i.e. technology, innovation or management practice)	**Management Practice**  Appropriate plant spacing in Kales
A: Description of the technology, innovation or management practice	
Problem addressed	Inappropriate spacing methods used by farmers leading to poor quality and yield of Kale
What is it? (TIMP description)	The ideal spacing and plant population are those that maximize yield and quality without unduly increasing costs. The appropriate spacing differs from one place to another depending primarily on the variety. The tall and spreading varieties require wider spacing while the dwarf ones require closer spacing. The recommended spacing of Kales seedlings is 60 cm between rows and 45-60 cm between plants in shallow holes that are 20 cm deep and 20 cm wide.

Justification	Most Kales farmers use wrong spacing and hence fail to achieve optimum plant density and the potential yields of the recommended varieties. Optimal plant density depends on variety, length of growing cycle, seasonal changes in the light and availability of nutrients in soil. There is need for demonstration and capacity building on the right spacing of Kales to achieve high yields.
Region promoted	Nyandarua, Kiambu, Nyeri, Kisii, Kirinyaga and Kericho
Counties where TIMP will be up-scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho and all other counties where Kale is being grown
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Service providers, Researchers, NGO's and other stake holders
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Extension service providers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile platforms
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale spacing for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility for spacing trials • 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 roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, National governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP

	• Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solution
C: Current situation and future scaling up	
County where TIMP has been promoted (if any)	Major Kales growing Counties
County where TIMP will be up scaled	Marsabit and all upcoming Kale growing areas
Challenges in dissemination	• Intercropping with other crops complicates the recommendations • Farmers may modify the recommendation due to associated practices e.g. irrigation Mode
Recommendations for addressing the challenges	• Validate spacing recommendations with specific intercrops • Promotion of simple and cheap planters • Reviewing/adjusting recommendation but still optimizing plant population
Lessons learned	Recommended plant spacing ensures optimum plant population and enhanced weeding operations and enhances yields
Social, environmental, policy and market conditions necessary	Organized marketing critical for benefits of the recommendation to be derived. This spacing also enhances optimum natural resources utility and therefore conservation of the environment
D**: Economic, gender, vulnerable and marginalized groups (VMGs) considerations**	
Basic costs	Not Done
Estimated returns	Not done
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Men perform most of the land preparation tasks therefore the TIMP may not be adopted if they are engaged in other activities. • Women may have less access to credit to purchase the required implements.
Gender related opportunities	Opportunity exist for women to access credit through the women entererprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to credit to purchase the required implements. • VMGs have less access to agricultural information, technology and knowledge than men. • Women have less access to education, training and extension. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials
VMG related opportunities	Opportunity exist for women to access credit through the women entererprise funds.

E: Case studies/profiles of success stories	
Success stories	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	Kales cultivation manual, brochure and fact sheet with detailed guide on recommended Kales spacing are documented
F: Status of TIMP Readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Director, KALRO Seeds E-mail: info.ptc@kalro.orgThe Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Antony N., Eliezah K.,Eliud G., , Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.7 TIMP Name	**Kales legume intercropping**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Farmers are experiencing low yields, crop failures, declined soil fertility and generally low farm returns from their investments. In addition, the problem of pests and diseases reduce yields.
What is it (Timp description)	The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. The practice allows different crops with varying rooting, shapes and nutrient requirements to co-exist on the same piece of land while both are contributing to the farm returns directly or indirectly. Single row intercropping: involves the component Kales and the legumes such as common beans arranged in alternate single rows. The space between the two Kales rows is 60cm and the legume is planted in between so that between beans and Kale row is 30cm. The beans are planted two weeks before transplanting Kales.

	In Strip intercropping**,** multiple rows, or a strip, of the legume is alternated with single or several rows of Kale.
Justification	Climate change is negatively impacting agricultural productions. Intercropping is one of the potential management practice of enhancing climate change adaptation. It offers the potential to increase yield, enhance soil fertility/biodiversity and minimize the effects of climate change. The practice is known to build healthy soils, control pests and harness a variety of benefits to increase yields. Intercropping of compatible plants encourages biodiversity by providing a habitat for a variety of insects and soil organisms that would not be present in a single-crop environment. An intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. In addition, the crop mixtures frequently have lower pest densities, especially of insect pests because the mixture confuses the insects and, if chosen carefully attracts beneficial predators. For instance, intercropping beans and Kales have been shown to reduce the aphid population in the Kale crop.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Researchers, NGO'sand wide range of users
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • Extension service providers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile platforms
Critical/essential factors for successful promotion	• Applied and adaptive research to identify suitable intercrop combinations • Mechanism for interaction of Kale value chain stakeholders • Seed availability and accessibility • Good seed system to ensure quality • Well organized farmer groups and networks • Good Marketing Models and path ways • County and National government support • Funding to research, validate and promote new Kale TIMPs • NGO's participation in mobilization and training

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, National governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	**C: Current situation and future scaling up**
Counties where already promoted, if any	Most counties in the medium to high rainfall areas & and semi-arid areas
Counties where TIMPs will be up-scaled	Most counties in the medium to high rainfall areas & and semi-arid areas
Challenges in dissemination	• Limited access and wide distribution of clean planting materials (intercrop varieties) • Inadequate access of technical materials on the establishment, operations and management of intercrop management practice by farmers • The increased effects of climate change hindering adoption.
Suggestion for addressing the challenges	• Enhance access of clean planting materials across the counties. Work closely with certified seed merchants, research institutions • Train and sensitize farmers on the basic principles of Intercropping, their benefits and types suitable to their contexts. • Use farmer field schools and demonstrations • Develop a comprehensive manual on the practice to guide the farmers during the adoption
Lessons learned In upscaling	The practice is very beneficial in pest management and Nitrogen fixation in the soil. Farmers can use a trap crop as an intercrop to attract pests, keeping them away from the main crop. Therefore, farmers can easily adopt this method to significantly cut down on pesticides input costs. Other intercrops have also been observed to suppress growth of weeds
Social, environmental, policy and market conditions necessary for development and scaling	• Intercropping Kale is a common practice hence socially accepted in many communities. • It is accepted by both male and female gender. • The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	This is a low cost management practice though technically demanding especially where the objective is to control pest through intercropping
Estimated returns	Dependent on the value chain intercrop
Gender issues and concerns in development ,dissemination, adoption and scaling up	• The technology may reduce women work burden when it comes to weeding. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Intercropping offers good opportunities for various gender categories e.g. men and women to grow diverse crops for economic gains.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Reduces labor demands across all gender categories. • VMGs have limited access to land for kale cultivation than men • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Intercropping places emphasis on the importance of using available land space to grow a diversity crops thus increasing biodiversity, pest management for VMGs economic and health gains.
Gender issues and concerns in development ,dissemination, adoption and scaling up	• The technology may reduce women work burden when it comes to weeding. Women have less access to agricultural information, technology and knowledge than men.
E: Case studies/profiles of success stories	
Success stories from previous similar project	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	Brochures, Publications, Apps
Status of TIMP readiness .1) Ready for upscaling; 2. Require validation; 3) Require further research R	Require validation
G: Contacts	
Contacts	The Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org Director, KALRO Seed Centre; E-mail: info.ptc@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Eliezah K.,Eliud G., Antony N., Charity G., Ruth A.,
	Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.

Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.4.8 TIMP Name	Crop rotation for increased yield
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low yield of Kales due to mono-cropping
What is it? (TIMP description)	It's a practice of growing different types of crops (or none at all) in the same area over a sequence of seasons. A basic principle of crop rotation is to avoid growing Kale in the same spot for consecutive years. In crop rotation there is interchanging of tap root crops with fibrous root crops, leguminous with non-leguminous, avoidance of crop of same family to follow one another to avoid pest and diseases build up.
Justification	Changing crops routinely allows the land to remain fertile since not all subsequent crops use the same nutrients. Crop rotation can help to manage soil fertility reduce soil erosion, improve soil health and increase nutrients availability to the kale plants.
Region promoted	All the Kale growing counties of Kenya
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Producers (farmers), extension agencies, NGO's, Researchers
Approaches used in dissemination	Kale Innovation Platforms Kale Farmer Field and Business Schools On farm and on station research trials and demonstrations Training workshops, Seminars, Meetings Field days Agricultural shows Extension service providers Farmer research networks Farmer to farmer Mass media – Agricultural programs Promotional materials (posters/brochures/leaflets, manuals) Web material's Mobile platforms

Critical/essential factors for successful promotion	Applied and adaptive research to release and validate Kale Agronomic practices for suitable crop rotation alternatives Mechanism for interaction of Kale value chain stakeholders Seed availability and accessibility Good seed system to ensure quality 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 roles	KALRO, National Agricultural Research Institutes (NARIs) and International research organizations Market players to create a demand and pull production Farmers/farmer groups to adopt and produce County governments, National governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination NGOs for farmer organizing and mobilization e.g. SACDEP 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	Nyandarua, Machakos, Busia, Kisumu, Lamu, Tana river, Uasin Gishu, Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Taita Taveta, Isiolo.
Counties where TIMPs can be up-scaled	Most counties in the medium to high rainfall areas & and semi-arid areas
Challenges in development and dissemination	In adequate knowledge on suitable and frequency of intercrops Limited support from the county government and national government Inadequate technology and research inputs
Suggestions for addressing the challenges	Enhanced dissemination Enhanced support from national and county government
Lessons learned in upscaling	Availability of Cost benefit information that can attract farmers to engage into the activities.
Social, environmental, policy and market conditions necessary	Capacity building on the importance of crop rotation. Supporting frameworks/policies at the local level
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low cost management practice but requires relatively large parcels of land to implement.
Estimated returns	Increased productivity and reduction of pest incidences has been reported.

Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth have limited access to land to practice crop rotation. Women and youth have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	Affirmative action opportunities exist for women and youth to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	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	Affirmative action opportunities exist for women and youth to access the required credit.
E: Case studies/profiles of success stories	
Success stories	CABI & KALRO were able to select and release 2 high yielding & pest/disease resistant varieties in 2010.
Application guidelines for users	Brochures, leaflets, Apps,
F. Status of TIMP readiness: 1. Ready for upscaling; 2. Require validation; and 3. Require further research	Ready for Upscaling
G: Contacts	
Contacts	Director, KALRO Seeds E-mail: info.ptc@kalro.orgThe Institute Director, KALRO-HRI Thika; E-mail: director.hri@kalro.org The Centre director, KALRO-Muguga Email: kalro.FCRC@kalro.org The Centre director, KALRO-Kabete; E-mail: cd.narl@kalro.org The Institute director, KALRO-FCRI Kitale; E-mail: director.fcri@kalro.org
Lead organization and scientists	Antony N., Eliezah K.,Eliud G., , Charity G., Ruth A., Japheth W., Fredrick W., Vincent O., Violet K., Wasilwa, L.
.Partner organizations	MoALF , Agricultural University Colleges, IFPRI.

2.5 SOIL FERTILITY MANAGEMENT

2.5.1 TIMP Name	**Intergrated Manure Management (IMM)**

Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	
Problem addressed	Land degradation characterized by the declining soil fertility, low crop yields, increased soil moisture stress, increased soil erosion and poor soil health, poor manure management and handling leading to increased Green House Gases (GHG) emissions
What is it? (TIMP description) 	Integrated Manure Management (IMM) is the optimal, site-specific handling of livestock manure from collection, through treatment and storage up to application to crops.
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. The estimated nutrient losses due to soil erosion, leaching and crop harvests are sometimes over 60-100 kg of Nitrogen (N), Phosphorus (P) and Potassium (K) per hectare per year. Manure plays an essential role in the nutrient cycle where crops and fodder grown on land are fed to livestock, which in turn feeds the soil with their manure. Managing manures to improve quality enhances the efficiency of crop production, and reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility through the supply of macro and micro nutrients. Well managed manure also improves soil health that leads to increased agricultural productivity, improved soil structure and below-ground biodiversity. Given that mineral fertilizers have become expensive, and out of reach for ordinary farmers, manure has the potential of providing the limiting nutrients and improving the soil health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On-farm and on-station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs

	• Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale ISFM practices for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their respective roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments • e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Kiambu, Murang'a, Nyeri, Nyandarua, Taita Taveta
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Lack of model demonstration farms • Labour challenges -Making pits and turning the manure • Cultural challenges for example acceptance by

	pastoral communities
	• Lack of continuity in training of extension and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	• Establishment of many demonstration by counties • Better managing ratios of dry matter and amounts of water/urine added to enable easier turning • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend demonstration forums
Lessons learned if any	• Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Skills in manure collection, preparation, storage and application
Social, environmental, policy and market conditions necessary	• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. • Propagation of invasive species when the seed is ingested by the animal and passed to crop field • Manure can harbor pathogens which can cause disease outbreaks to 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	Material depedent
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practiced
Gender issues and concerns in development and dissemination	• It is labour intensive in terms of handling and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kale cultivation than men. • Women and youth may also have limited access to inputs such as manures than men. • Women have less access to agricultural information, technology and knowledge than

	men.
Gender related opportunities	• Opportunity exist for women to access the the required credit through the women entererprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs may also have limited access to finances to buy the required inputs such as manures than men. • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production due to use of manure will lead to increased consumption and utilization of kale and hence improved health of VMGs.
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income
Application guidelines for users	Brochures, Factsheets Manuals
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO S. Kimani, E.Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A.O. Esilaba, H. Odhiambo, Wandera. F.M
Partner organizations	County government, Private Public Partnerships

Research Gaps

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

2.5.2. TIMP name	**Integrated Soil Fertility Management (ISFM)**
Category (i.e. technology, innovation or management practice)	Complementary technology
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)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed combined to adapt practices to local conditions. It places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence).
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. The estimated nutrient losses due to soil erosion, leaching and crop harvests are sometimes over 60-100 kg of Nitrogen (N), Phosphorus (P) and Potassium (K) per hectare per year. In addition, soils within the farming systems are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use, combining mineral fertilizers with animal manure, crop agronomy and quality seed use. ISFM therefore aims to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale ISFM practices for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Kiambu, Nyandarua, Taita Taveta

Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenges in dissemination	• Change of mindset in some regions/cultures that organic manures cannot be applied on crops • Lack of awareness on how to combine manures with mineral fertilizers organic manures cannot be applied on crops • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	• Awareness trainings on role of organic manures in crop cultivation • Awareness creation on how to combine animal manure with modest amounts of mineral fertilizers for crop production • 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	• 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	• It is labour intensive hence may not be adopted by women who are already overburdened. • Women and youth have limited access to to credit to purchase the required inputs such as such as fertilizers than men. • Women and youth have limited access to land for kale cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunity exist for women to access the the required credit through the women enterprise funds.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • It is labour intensive hence may not be adopted by some VMGs who are elderly. • Women and youth have limited access to to credit to purchase the required inputs such as such as fertilizers than men.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Increased production due to use of the TIMP will lead to increased consumption and utilization of kale and hence improved health of VMGs.
E: Case studies/profiles of success stories	
Success stories	ISFM successes have been reported in maize in the Kabete long-term experiment, in highlands of Kenya east and west of the Rift. In addition, ISFM has been reported in sorghum and millet value chains in Machakos. In all these regions, productivity has been improved
Application guidelines for users	Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients. Ensure that good agronomic practices are upheld For sustainability, lone use of inorganic or organic materials should be avoided.
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Requires further research and validation
G: Contacts	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. O. Esilaba, J. Ndufa, F.M. Wandera
Partner organizations	County governments KEFRI

Research gaps

Validation of the ISFM technology in counties where technology has not been tested.

Testing (fertilizer types, rates, frequencies) with different value chains singly and in combination with manures

2.5.3. TIMP name	**Rapid soil testing services**

Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Conventional methods for soil testing are not cheap to farmers, results take long and not are reproducible. The methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols. Limited access to soil testing services (centralized soil testing laboratories and cost).
What is it? (TIMP description)	This is a dry method for soil testing which does not require laborious laboratory analysis. The method uses simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. It requires partners involved (ICRAF, iSDA and Soil Cares) to work closely with KALRO and County agricultural officers to sensitize farmers to embrace the testing method.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers' ability to make informed decisions with regard to soil management and fertilizer use.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers, Agrodealers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone

Critical/essential factors for successful promotion.	• Applied and adaptive research to release and validate Kale ISFM practices for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • Agro dealers • 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	Bungoma, Trans Nzoia, Nyeri, Nyandarua
Counties where TIMP will be up scaled	All other Counties with suitable agro-ecological settings for Kale production.
Challenges in dissemination	• It requires continuous updating methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	• Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated pipelines for updating existing recommendation methods.

Lessons learned in upscaling if any	• Timely affordable soil information will guide on fertilizer use. Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step to understand what the soil demand in • terms of macro, micro nutrients and trace elements like Zinc and Sulphur.
Social, environmental, policy and market conditions necessary	• Socially acceptable-brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The 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 horticultural production profitable.
Gender issues and concerns in development and dissemination	• It is labour intensive hence may not be adopted by women who are already overburdened • Women and youth have limited access to to credit to purchase the required inputs such as such as fertilizers than men • Women and youth have limited access to land for kale cultivation than men • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Opportunity exist for women to access the the required credit through the women enterprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • It is labour intensive hence may not be adopted by some VMGs who are elderly. • Women and youth have limited access to to credit to purchase the required inputs such as such as fertilizers than men.

VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production due to use of the TIMP will lead to increased consumption and utilization of kale and hence improved health of VMGs • consumption and utilization of kales hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories	Has been tested used successfully by other organizations like ICRAF, Soil Cares & KESREF. It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugarcane.
Application guidelines for users	A hand held scanner to testing soils and crops in the field Community soil sampling champions are identified and trained on good soil sampling procedures. Soil and crop sample is analyzed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Requires validation
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO secretariat
Lead organization and scientists	KALRO; F.M Wandera, A. Sila, D. Kamau, E. W. Gikonyo and A.O. Esilaba
Partner organizations	County governments in the 24 counties, Soil Cares, ICRAF and iSDA

Research Gaps

Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.

Determine nutrient deficiency and make recommendation for the type of fertilizer to use and at what rate.

Developing a fertilizer recommendation system with options for new blends.

Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities per farmer needs.

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.

Updating existing soil maps with newly acquired soil data library to provide current soil fertility status in the country.

2.5.4 TIMP Name	**Low-Cost Composting**
Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	
Problem addressed	Organic wastes constitutes the highest percentage of waste flow in Kenya leading to big landfills especially near the urban centres. 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 Emissions
What is it? (TIMP description)  Composting using plant residues	Composting is the biological decomposition of organic waste such as food or plant 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 thus one of the most effective processes for recycling organic wastes intended for use in agriculture
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. The decline in soil fertility is compounded by leaching of applied nutrients, soil erosion and continuous cultivation and crop harvest without adequate nutrient replenishment. Compost contains the nutrients nitrogen, phosphorus and potassium and that are found in most chemical fertilizer as well as secondary nutrients-Calcium, Magnesium and Sulphur and trace elements (such as zinc, Iron and Boron. The compost also adds balanced nutrients to soil in an easily assimilated form, and helps improving soil structure by lightening heavy clays and improving water retention properties in porous sands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Urban Agriculture Forums • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Composting practices for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Nyeri, Nyandarua, Taita Taveta

Counties where TIMP will be promoted	All 24 KSAP counties
Challenges in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Suggestions for addressing the challenges	• Applied and adaptive research to release and validate manure composting practices for selected varieties • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Lessons learned if any	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • Seed companies for quality seed multiplication • Financial institutions e.g. Banks, donors and other credit facilitators for financial solutions

Social, environmental, policy and market conditions necessary	Composting requires care when handling wastes that would normally contain heavy loads of pathogens and aim at removing non-biodegradable and hazardous waste and controlling odours and flies. Also compost pits if not well managed can also be a source of contamination by leaching of nutrients. Generally, applying composts to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water. Hence socially and environmentally acceptable
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	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 practiced
Gender issues and concerns in development ,dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kale cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youth's male's employment exist in the task of composting.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	Opportunities for youth's males' employment exist in the task of composting.
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	<u>Reference</u> 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	Requires validation Requires further research, for instance use of bio-slurry in compost making
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, B. Mugo, D. Kamau, E. Mutuma, M. Okoti
Partner organizations	County government, NGO's

Research Gaps

Promote composting technology in counties that have not practiced it.

Use of bio-slurry in making composts

Conduct nutrient budget study on selected farms using composts in the 24 Counties.

2.5.5 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; low soil water retention capacity in most soils
What is it? (TIMP description)  Contour bands	Contour bunds are stone or earthen walls built across a slope to prevent runoff. Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus, contour bunds resemble narrow channel terraces commonly referred to as "F*anya chini"* terraces. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Contour bunds resemble narrow channel terraces commonly referred to as *"Fanya chini"* terraces. The aim of contour bunds and hedgerows is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. This also decreases the risk of erosion. Plants with higher water requirements, such as Kale, peas or beans, can be planted on the higher side of the furrow whereas cereal crops requiring less water, such as sorghum or millet, can be planted on the ridges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers

Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	All kale growing counties
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenge(s) in development and dissemination	• Increased risk of soil erosion if contours are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership,

	or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of Contour for efficiency and increased output per man hour. • Training youthful farmers to be champions of Contour bunds construction at the Ward level/village level. • Training on site specific designs and construction of contour bunds • Fast-track land regist ration
Lessons learned, if any	• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low-cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *contour* preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development ,dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kale cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youth's males' employment exist in the task of contour bunds.
VMG issues and concerns in development, dissemination,	• VMGs have limited access to land for kale cultivation than men

adoption and scaling up	• Women have less access to agricultural information, technology and knowledge than men • The technology is labour intensive and may be difficult for the VMG to implement in the field
VMG related opportunities	Opportunities for youth's males' employment exist in the task of contour bunds.
E: Case studies/profiles of success stories	
Success stories, if any	Most Vegetables growing conties
Application guidelines for users	Manuals, Fact sheets, Brochures
F: Status of TIMP readiness (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Government's extension offices.

Research Gaps

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

2.5.6 TIMP name	***Zai* Pits**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Unreliable water to sustain a crop as a result of high seasonal rainfall variability leading to total crop failures. Decreased yields leading to food insecurity.

What is it? (TIMP description)  Kales in Zai pits	*Zai Pits* are small planting pits typically measuring 15-30 cm in width, 10-20 cm deep and spaced 60-80 cm. *Zai Pits h*arvests and stores water for prolonged crop use. Farmers plant seeds into the pits after filling one to three handfuls of organic material such as manure, compost, or dry plant biomass. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. *Zai Pits* technology has the potential to harvests and store rain water for prolonged crop use. This technology also contributes to improving the management of degraded lands, reducing soil erosion, vegetation loss and biodiversity as well as crop yield.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenge(s) in development and dissemination	The greatest challenge is that the technology is labour intensive and many farmers may find it difficult to implement at large scale.
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of *Zai* pits for efficiency and increased output per man hour. • Training youthful farmers to be champions of *Zai* pits construction at the Ward level/village level.
Lessons learned, if any	The technology has huge potential to increase farmers' resilience especially in ASALs. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest in it to maximize yields.
Social, environmental, policy and market conditions necessary	• Enforcement of policies on soil and water conservation at the County level • Creation of awareness on the importance of soil and water conservation • Provision of low-cost technologies for soil and water conservation • Policies that support individual land tenure systems • Provision of support in the establishment of the *Zai* pits
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *Zai pit* preparation. It is estimated at KES 40 to 100 per *Zai Pit*
Estimated returns	To be determined
Gender issues and concerns in development and dissemination	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kale cultivation than men.

	• Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youths males employment exist in the task of contour bunds.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men • Women have less access to agricultural information, technology and knowledge than men • The technology is labour intensive and may be difficult for the VMG to implement in the field
VMG related opportunities	Opportunities for youths males employment exist in the task of contour bunds.
E: Case studies/profiles of success stories	
Success stories, if any	Two women groups in Kiliki, Matungulu sub-County of Machakos County through a representative Janet Ndunge reported having started using the *Zai pit* farming technology in 2013 after attending a farming workshop by the Institute for Culture and Ecology (ICE). "Ever since we started using *Zai pits*, we have seen an increase in our harvests as compared to the conventional methods of farming," she said. Farmers in Kathonzweni, Makueni County increased dug pits from 170 to 500 pits for crop production due to initially observed benefits. Communities in ASALs have also rehabilitated degraded lands and increased production by many folds.
Application guidelines for users	Zai pits are 5-15 cm deep, 15-50 cm wide and 80-100 cm apart. In dry areas the size of planting pits can be enlarged. Compost or manure is placed in the pits before planting to improve soil fertility. It is not necessary to follow the contour when constructing pits. Compost or manure is placed in the pits before planting to improve soil fertility. It is not necessary to follow the contour when constructing pits. The Zai pits are during the dry season when labour constraints are minimal. Each pit is 20-30 cm wide, 10-30 cm deep, with the soil from the pit thrown downhill to form a crescent shaped dam. The spacing of the pits within a row, as well as the space between the rows of pits varies between 60 and 100 cm. At the beginning of the rains, 200-600 g of dung or compost (two handfuls of organic matter are approximately 300 g) are added to the pits. The organic matter is mixed, in the bottom of the hole, with approximately 5 cm soil. Each pit is then sown with 8-12 millet or sorghum seeds.
F: Status of TIMP readiness (Ready for up scaling, Requires validation; Requires further research)	Ready for up scaling
G: Contacts	

Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Ketiem, J. Mwaura; D. Kamau and A.O. Esilaba.
Partner organizations	County Government's extension offices.

Research Gaps

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

2.5.7. 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 run off; low soil water retention capacity in most soils
What is it? (TIMP	Bench terraces consist of a series of beds which are more or less
description)  Bench terraces	level running across a slope at vertical intervals, supported by steep banks or risers (walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for Semi-arid to humid regions of rainfall, 700 mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones.
Justification	Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenge(s) in development and dissemination	• Increased risk of soil erosion if terraces are improperly laid out • Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale

	• Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour. • Training youthful farmers to be champions of making bench terraces construction at the Ward level/village level. • Training on site specific designs and construction of bench terraces • Fast track land registration
Lessons learned, if any	• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low-cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for *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	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kales cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Opportunities for youths males employment exist in performing the task of bench terraces.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kales cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Opportunities for youths males employment exist in the task of bench terraces.
E: Case studies/profiles of success stories	
Success stories, if any	Mukethe Mbithi is a member of the Kyungu Mwethya group in Machakos "Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed. But when we made terraces the soil erosion stopped and we got good crops. So, I encourage other farmers especially in dry areas to try this new technology for their crops”
Application guidelines for users	Brochures, Manuals, Factsheets, leaflets
F: Status of TIMP readiness (Ready for upscaling, Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Government’s extension offices.

2.5.8TIMP name	**Stone lines**
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)	Stone lines are stones placed along contour lines to slow down runoff. With time, the soil builds up on the upslope side of the stone line and a natural terrace is formed. The technology is suitable in gentle to moderate slopes (less than 10%); areas with low annual rainfall areas (200 - 750 mm); and stony areas
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Stone lines can help in the conservation of soil and moisture.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenge(s) in development and dissemination	• Increased risk of soil erosion if stone lines are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don’t have land title deeds
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate tools for preparation and laying of stones lines for efficiency and increased output per man hour. • Training youthful farmers to be champions of laying stone lines and maintenance. • Training on site specific designs and laying of stone lines • Fast-track land registration
Lessons learned, if any	• Existence of well-developed self-help groups can lead to successful construction of stone lines. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation

	• Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	For each hectare, transport and other project costs amount to around KES 25,000.
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development ,dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kales cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Employment opportunities for the various gender categories i.e. youths women and men performing the task.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kales cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Employment opportunities for youths exist in performing the task.
E: Case studies/profiles of success stories	
Success stories, if any	In Burkina Faso farmers have reported doubled cereal production when stone lines are used in combination with greater use of compost as fertilizer. https://www.rural21.com/fileadmin/_migrated/content_uploads/Stone_lines_against_desertification_01.pdf
Application guidelines for users	Brochures, Factsheets, Manuals and leaflets
F: Status of TIMP readiness (1-Ready for upscaling, 2-Requires validation; 3-Requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-

	2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba and H. Odhiambo
Partner organizations	County Government's extension service.

2.5.9 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)  Retention ditches	Retention ditches are trenches designed to catch and retain incoming runoff and hold it until it infiltrates into the ground. They can be an alternative to waterways in high rainfall areas, but they are most often used in semi-arid areas to harvest water. The technology is suitable in semi-arid areas; permeable, deep and stable soils; and on flat or gentle sloping land.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of retention ditches has led to better and more reliablecrop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's

	• Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenge(s) in development and dissemination	• Increased risk of soil erosion if retention ditches are improperly laid out • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don’t have land title deeds

Suggestions for addressing the challenges	• Farmers need to be supported with appropriate tools for digging out retention ditches for efficiency and increased output per man hour. • Training youthful farmers to be champions of digging out retention ditches. • Training on site specific designs and layout • Fast-track land registration
Lessons learned, if any	When the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low cost technologies for soil and water conservation • Policies that support individual land tenure systems
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for digging retention ditches. 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	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for kales cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Employment opportunities for the various gender categories i.e. youths women and men performing the task.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kales cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Employment opportunities for youths exist in performing the task.
E: Case studies/profiles of success stories	
Success stories, if any	Over 50,000 smallholder farmers in Eastern and Central Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging ofretention trenches in hillside to trap runaway water and soil.
Application guidelines for users	Brochures, Leaflets, Manuals and Factsheets
F: Status of TIMP readiness 1-Ready for	1-Ready for upscaling

upscaling, 2-Requires validation; 3- Requires further research)	
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020- 2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba and H Odhiambo.
Partner organizations	County Government's extension service.

2.5.10 TIMP name	**Grass strips**
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)	Grass strips are dense strips of grass panted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively good rainfall. The technology is suitable in regions with fairly gentle slopes (0 - 6%); grass is needed for fodder; and high rainfall areas.
Justification	Agricultural production is threatened in many parts of the Kenya by soil moisture stress and serious soil erosion. Conservation of soil andmoisture through construction of grass strips has led to better and more reliable crop yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone

Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kaleproduction.
Challenge(s) in development and dissemination	• Labour intensive for maintaining and controlling grass from becoming a weed • Reduced land area for crop production
Suggestions for addressing the challenges	• Farmers need to be supported with appropriate tools and suitable grass varieties. • Capacity building on the maintenance of grass strips. • Training on site specific designs and layout
Lessons learned, if any	• Establishment of grass strips induces a process of natural terracing on slopes as soil collects behind the grass barrier, even in the first year. • Grass strips can be very appropriate for farmers who cut and carry fodder for their animals. • Grasses are also used as mulch for crops by farmer
Social, environmental, policy and market conditions necessary	• Enforce policies on soil and water conservation at the County level • Create awareness on the importance of soil and water conservation • Avail low-cost technologies for soil and water conservation
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for establishing grass strips. The cost will depend on the type of grass to be planted, land size and the landscape terrain/slope

Estimated returns	The returns depend on the value chain being addressed and also type of grass
Gender issues and concerns in development ,dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cashew cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Employment opportunities for the various gender categories i.e. youths, women and men performing the task.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cashew cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Employment opportunities for youths exist in performing the task.
E: Case studies/profiles of success stories	
Success stories, if any	
Application guidelines for users	Brochures, Leaflets, Manuals Factsheets
F: Status of TIMP readiness (1-Ready for upscaling, 2-Requires validation; 3-Requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M, Wairimu; P. Kitiem, J. Mwaura; D. Kamau, A.O. Esilaba and H. Odhiambo.
Partner organizations	County Government’s extension service.

2.5.11 TIMP name	**Tied ridges /Ridging /Earthing**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Crop water stresses in production; Increased water losses in the furrows

What is it? (TIMP description)  Tied Ridges	Tied ridges are small earthen ridges, 30 cm high, with an upslope furrow which accommodates water between the ridges. Technology consist of water flowing down the small trenches/furrows running parallel and infiltrates into crop root zones. Water is applied to the top end of each furrow and flows down the crop field under the influence of gravity.
Justification	With limitations in soil moisture due to decreasing rainfall occasioned by climatic changes, tied ridges helps conserve soil moisture. In combination with furrow irrigation, the technology has potential to improve agricultural productivity and increase crop yields and cropping intensities. As a result, household food security, incomes and livelihoods are enhanced.
Region promoted	Machakos, Embu. Makueni, Tana River, Garissa, and West Pokot counties
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials • (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • e.g. SACDEP • 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	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenges in dissemination	• Can be labour intensive during establishment phase • Poor management may lead to water use inefficiencies • Limited access to credit may limit uptake • Land tenure insecurity in some counties limits adoption and investments
Recommendations for addressing the challenges	• Enhancing farmers' capacity to see benefits • Enhance access to credit • Implement policy on land use and tenure
Lessons learned	• Use of tied ridges with furrow irrigation significantly increases yields • Poor management and designs may often result in flooding of low areas • Assessment of soil erosion and sediment is key to sustainability
Social, environmental, policy and market conditions necessary	• The economics of furrow irrigation needs to be well articulated • Enhanced land quality control to mitigate against soil salinity • Adequate policies and guidelines regarding water abstraction from the main water sources to minimize resource conflicts especially along river downstream. • Market for the crops produced under irrigation should be identified early enough to minimize losses • and increase profitability from the system
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not known
Estimated returns	Not known

Gender issues and concerns in development ,dissemination, adoption and scaling up	• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for cashew cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Employment opportunities for the various gender categories i.e. youths, women and men performing the task.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for cashew cultivation than men • Women have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	Employment opportunities for youths exist in performing the task.
E: Case studies/profiles of success stories	
Success stories	There are successful models for such technology i.e. Mwea and Perkerra irrigation schemes where furrow irrigation systems have provided opportunities for local community to produce high value crops. A sound understanding of the roles and responsibilities of farmers and water user associations is a feature of successful system.
Application guidelines for users	Sijali I V. Drip irrigation: options for smallholder farmers in Eastern and southern Africa. 2001. RELMA Technical Handbook Series 24. Nairobi, Kenya: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency, (Sida). 60 p. + x p.; includes bibliography FAO CSA Manual FAO Irrigation Water Management: Irrigation Manual GoK/ MoALF: Training Manual for Water Users Association and farmers
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO; J. Mwaura, I. Sijali
Partner organizations	National Irrigation Board (NIB), Water Resources Management Authority

Research Gaps

1. The economic viability of the technology in different agro ecological zones need to be done

2.5.12 TIMP name	**Rain water harvesting systems**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed:	Water scarcity for crop and livestock use especially in the face of diminishing rainfall because of climate change
What is it? (TIMP description)	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). A vast number of techniques allow flexibility and adaptability to site- specific situations to best fight water scarcity and make agricultural production more resilient. One method of rainwater harvesting is rooftop harvesting and harvesting through earth dams.
Justification	Water, especially in the ASALs, is the most limiting factor to land productivity. It is also a major driver of soil erosion and land degradation. Therefore, there is need to enhance water harvesting and storage By collecting, storing and utilizing water agricultural purposes, farmers are able to prevent soil erosion, stabilize water supply, and reduce reliance on other water sources. Smallholder farmers can also recoup initial investment costs in water harvesting by planting high- value crops, and extending their growing season through the entire year. Technology also slows water runoff and increases yields with the additional water.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, pastoralists and agro-pastoralist
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone

Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Most counties are investing on water harvesting technology at community level. More is required to increase uptake by farmers in ASALs.
Counties where TIMP will be up scaled	ASAL counties; Tana River, Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, All other Counties with suitable agro-ecological settings for Kale production., Garissa, Mandera and Wajir
Challenges in dissemination	• High costs related to technology access and management • Resource use conflicts where land is communally owned • Limited skills in technology installation and management • Limited community mobilization policy for water related activities • Lack of suitable training programs in rainwater harvesting • Lack of proper water usage and control measures • In the case of earth dams where there is a lot of siltation, regular de-siltation is required • Threats to sustainability of established systems because of lack of community participation in systems monitoring and maintenance

	• Vandalism • Some systems require high investment costs.
Suggestions for addressing the challenges	• Resource mobilization through partnerships with private sector • Engaging a participatory process during the planning and implementation of the project. • User specific training programs water harvesting technologies, maintenance and operation skills • Cost of buying water harvesting structures is very high for most households and needs to be reviewed. • Securing systems to prevent vandalism
Lessons learned in upscaling, if any	• Potential to caution community against water scarcity • Improved productivity where water harvesting has been implemented.
Social, environmental, policy and market conditions necessary	• Devise systems that are gender sensitive – target different gender needs • Carry out environment and social impact assessment of the technology in specific Counties and cultures • Support structures that help access to credit for technology access and maintenance • Enact Policy frameworks to support water harvesting • Enact policies on land tenure systems to support water harvesting
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined Not affordable to most rural households.

Estimated returns	• Time saved fetching water from afar is channeled into other economic enhancing activities. • Money used to treat diseases related to poor water hygiene is used for other activities. • Healthy population will have energy to provide labour required in agricultural activities
Gender issues and concerns in development ,dissemination, adoption and scaling up	• The technology will save time used by women in fetching water therefore allowing them to perform other productive activities. • Women and youth have limited access to land for kales cultivation than men. • Women and youth may also have limited access to finances to buy the required materials for implementation of the technology. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Employment opportunity exist for youth during implementation of the TIMP.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kales cultivation than men. • VMGs may also have limited access to finances to buy the required the required materials for implementation of the technology. • Women have less access to agricultural information, technology and knowledge than men. • The technology will reduce the time used in fetchingwater by the VMGs.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Employment opportunity exist for youth during implementation of the TIMP.
E: Case studies/profiles of success stories	
Success stories	Agro-pastoralists who adopted water harvesting technology have had sustained source of income and improved livelihoods. A typical African Water Bank rainwater harvesting system collects 400,000 to 450,000 litres of rainwater within two to three hours of steady rain. It has an artificial roof of 900 to 1,600 square metres and storage tanks. The largest tank constructed in Narok County has a capacity of 600,000 litres. This amount of water can serve a community of 400 people for approximately 24 months without extra rain. The capacity can be added at a rate of 220,000 litres per year. The system is low cost and can be 100 percent maintained locally. It also uses local skills, labour, materials and technology. Apart from boosting access to water in arid and semi regions, rainwater harvesting contributes to water conservation thus reducing overexploitation of water

	resources.
Application guidelines for users	• Handbook on Rainwater Harvesting and Storage Options • Manual for Rooftop Rainwater Harvesting Systems in the Republic of Yemen
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, Isaya Sijali, J. Mwaura, P. Ketiem
Partner organizations	County government, PPP

Research Gap

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

2.5.13. 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:	Land degradation characterized by the declining soil fertility, low crop yields, increased soil moisture stress, increased soil erosion and loss of biodiversity
What is it? (TIMP description)  Conservation Agriculture: maximum ground cover	Conservation agriculture is management practice which maximizes on saving water on the farming byadhering to specific principles that govern it. The practices that make up this approach follow key principles that target to conserve the soil, soil moisture, and soil-nutrients, and stabilize land production while reducing production costs. Conservation agriculture principles are: 1. Minimal soil disturbance, 2. Permanent ground cover - maintenance of a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops), 3. Crop rotation or sequences and associations of crops including trees, which could include nitrogen-fixing legumes

Justification	Land productivity is decreasing leading to decreased yield. Continuous land operation continues to emit more GHGs (Carbon) responsible for the climatic changes. Conservation agriculture (CA) has potential to: Enhance management of soil fertility and organic matter, and improvement of the efficiency of nutrient inputs, helping to produce more with proportionally less fertilizer. Rotations and crop associations that include legumes are capable of hosting nitrogen-fixing bacteria in their roots; this contributes to optimum plant growth without increased GHG emissions induced by fertilizer production Avoidance of tillage minimizes occurrence of net losses of carbon dioxide by microbial respiration and oxidation of the soil organic matter and builds soil structure and bio pores through soil biota and roots. The protective soil cover of leaves, stems and stalks from the previous crop shields the soil surface from heat, wind and rain, keeps the soil cooler and reduces moisture losses by evaporation. Helps to reduce soil compaction and plough pans and regenerates degraded lands
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Agents, Researchers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material’s • Mobile phone

Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up, their roles and stage of involvement	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments • e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • e.g. SACDEP • 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	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega
Counties where TIMP will be up-scaled	All other Counties with suitable agro-ecological Settings for Kale production.
Challenges in dissemination	Non-availability of crop residue in suitable quantities
	• Competition for crop residues with other uses like wood fuel and livestock • Land tenure (farmers reluctant to invest in CA where they do not have clear land rights) • Limited knowledge on the incremental benefits of CA • Limited access to CA implements

Suggestions for addressing the challenges	• Enhance Public Private Partnerships (PPP) to support increased production and market access • Improve KALRO and County government capacity to train and re-tool technical team so as to enhance uptake of the technology • Allocation of more funds for continued research and dissemination of this technology would aid • increased uptake of CA with agroforestry
Lessons learned in upscaling if any	• Uptake of CA technology increases with the realized incremental benefits over time • Continuous capacity building increases CA technology uptake
Social, environmental, policy and market conditions necessary for development and dissemination	• Develop Integrated Herbicide Management Plan – pre-emergence and post-emergence herbicides • Reliable technology adoption and suitable price and market access for produce under CA • Continuous capacity building of the community on the benefits of CA technology • County policies that support households investing in CA with inputs like implements
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Costs related to ripping services and herbicides amount to KES 5000/acre. This is apart from the normal inputs of seed and fertilizer when establishing. But the costs of reduce over the years, while the returns increase
Estimated returns	• Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation • Returns on conserving soil exceeding 150 ton/hectare annually and associated increased productivity
Gender issues and concerns in development ,dissemination, adoption and scaling up	• The technology may reduce women work burden when it comes to weeding. • Women and youth have limited access to land for kales cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	CA with trees is a management practice that that can be easily adopted by women.

VMG issues and concerns in development, dissemination, adoption and scaling up	• The technology may reduce VMGs work burden when it comes to weeding. • VMGs have less access to agricultural information, technology and knowledge than men. • VMGs have limited access to land for kales cultivation than men.
VMG related opportunities	• CA with trees is a management practice that that can be easily adopted by VMGs. • Increased production will lead to increased consumption and utilization of kales hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	**References** Okoba, B. (2018), Climate-Smart Agriculture: Training Manual for Agricultural Extension Agents in Kenya. Esilaba, E.O (2019), KCEP-CRAL CSA Extension Manual SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Conservation Agriculture. Sustainable Agriculture Information Initiative, Nairobi
F: Status of TIMP readiness (Ready for upscaling; Requires validation; Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, E. Mutuma
Partner organizations	County government, Private Public Partnerships

Research Gaps

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

2.5.14 TIMP name	**Kale-legume intercropping**
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem addressed:	Management practice addresses the challenges of decreased yields, hence low farm returns, declining soil fertility, hence soil degradation, Soil erosion problems (runoff i minimized) Weeds infestation (manage using increased soil cover crops), Vulnerability to crop pests where the practice helps slow the proliferation of pests and protect yields
What is it? (TIMP description)	Intercropping is a multiple cropping practice involving growing two or more crops in together. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources or ecological processes that would otherwise not be utilized by a single crop. The practice offers the potential to increase yields, enhance soil fertility and minimize the effects of climate change. **Single row intercropping:** involves the component Kale and the legume arranged in alternate single rows. Spacing. The space between the two Kale rows is 120cm and the legume is planted in between so that between legume and row row is 60cm. **Strip intercropping:** multiple rows, or a strip, of the legume is alternated with single or several rows of Kales. Spacing. The inter row spacing between legume is 45cm and legume to Kale is 60 cm. The space between two Kale rows is 60cm. **Control of pest through intercropping** **Push-pull cropping,** this is a mixture of trap cropping and repellent intercropping. An attractant crop attracts the pest and a repellent crop is also used to repel the pest away. **Trap cropping,** this involves planting a crop nearby that is more attractive for pests compared to the production crop, the pests will target this crop and not the production crop. **Repellent intercrops,** an intercrop that has a repellent effect to certain pests can be used. This system involved the repellent crop masking the smell of the production crop in order to keep pests away from it.

Justification	Climate change is negatively impacting agricultural productions. Farmers are experiencing low yields, crop failures, declined soil fertility and generally low farm returns from their investments. Intercropping is one of the potential management practice of enhancing climate change adaptation. It offers the potential to increase yield, enhance soil fertility/biodiversity and minimize the effects of climate change. The practice is known to build healthy soils, control pests and harness a variety of benefits to increase yields. Intercropping of compatible plants encourages biodiversity by providing a habitat for a variety of insects and soil organisms that would not be present in a single- crop environment. The practice have several advantages. First, an intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. Secondly, crop mixtures frequently have lower pest densities, especially of insect pests. This occurs both because the mixture confuses the insects and, if chosen carefully attracts beneficial predators. Finally, intercropping may allow more effective management of cover crops.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and wide range of users
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation

Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Most counties in the medium to high rainfall areas & arid and semi- arid areas
Counties where TIMP will be up scaled	All the Kale KCSAP Counties that will include Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, All other Counties with suitable agro-ecological settings for Kale production, including Garissa, Mandera and Wajir
Challenges in dissemination	Limited access and wide distribution of clean planting materials (intercrop varieties)
	• Inadequate access of technical materials on the establishment, operations and management of intercrop management practice by farmers • The increased effects of climate change hindering adoption. • Farmer high poverty levels coupled with illiteracy especially in deep rural areas of Kenya.
Suggestions for addressing the challenges	• Enhance access of clean planting materials across the counties. Work closely with certified seed merchants, research institutions • Train and sensitize farmers on the basic principles of intercropping, their benefits and types suitable to their contexts. Use farmer field schools and demonstrations • Develop a comprehensive manual on the practice to guide the farmers during the adoption
Lessons learned in up- scaling, if any	• The practice is very important in pest management. Farmers can use a trap crop to attract pests, keeping them away from the main crop. • Therefore, farmers can easily adopt this method to significantly cut down on pesticides input costs • The number of ecological benefits provided by this practice can also accelerate up scaling. Intercropping promotes interactions between crops and pollinators, thus supporting biodiversity and wildlife species.

Social, environmental, policy and market conditions necessary	• Socially accepted by both male and female gender. • The practice is environmentally friendly as it enhances biodiversity, controls erosion and minimizes use of pesticides
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low cost management practice though technically demanding especially where the objective is to control pest through intercropping
Estimated returns	Dependent on the value chain intercrop
Gender issues and concerns in development ,dissemination, adoption and scaling up	• The technology may reduce women work burden when it comes to weeding. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Intercropping offers good opportunities for various gender categories e.g. men and women to grow diverse crops for economic gains.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Reduces labor demands across all gender categories. • VMGs have limited access to land for kales cultivation than men • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	Intercropping places emphasis on the importance of using available land space to grow a diversity crops thus increasing biodiversity, pest management for VMGs economic and health gains.
E: Case studies/profiles of success stories	
Success stories	Farmers have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally an increased crop production following application of this widely used and readily available management practice.
Application guidelines for users	Brochures, Leaflets, Manuals & Factsheets
F: Status of TIMP readiness (Ready for upscaling: Requires validation; Requires further research	Requires further research
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, P. Ketiem, E. Mutuma, M. Okoti, , D. Kamau, A.O. Esilaba
Partner organizations	County governments, KCEP-CRAL project

Research Gaps

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

2.5.15 TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Accelerated loss of soil moisture-water stress in thesoil. Suppression of weeds, loss of organic matter, managing salinity in ASALS.
What is it? (TIMP description)  Mulching in Kales	The practice of covering the soil/ground with natural materials such as straw, dead leaves and compost tomake more favourable conditions for plant growth, development and efficient crop production. Benefits: retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose).
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

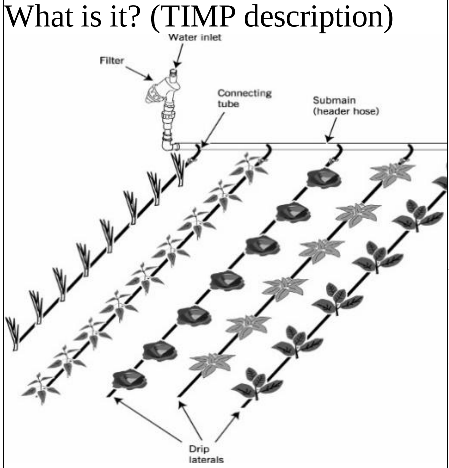
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials • (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • e.g. SACDEP • 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	Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos.
Counties where TIMP will be promoted	All the other 17 counties which includes Laikipia, West Pokot, Taita Taveta, Baringo, Turkana, All other Counties with suitable agro-ecological settings for Cabbage production., Garissa, Mandera and Wajir
Challenges in dissemination	• 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	• Crop diversification to increase availability of residues. • Establish and follow a good integrated pest control management program for the particular crop. • Adapting alternative mulching materials like high absorbance polymers in fruit trees like mangoes and Bananas.
Lessons learned	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	• 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	• Mulching is labour intensive hence it may increase the labour burden for the various gender categories. This may lead to the technology not to be adopted especially by women who are already overburdened. • The TIMP will reduce women's weeding time that can be used performing other productive activities.
Gender related opportunities	• The TIMP can offer employment opportunities for the youths. • The mulch is locally available on-farm.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Since the activity is labour intensive it may increase the labour burden for the various gender categories. This may lead to the technology not to be adopted. • The TIMP will reduce women's weeding time that can be used performing other productive activities.
VMG related opportunities	• The TIMP can offer employment opportunities for the youths.

	• The mulch is locally available on-farm.
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 generallyincreased crop production following application of mulching technology.
Application guidelines for users	Brochures, Leaflets, Factsheets and Manuals
F: Status of TIMP readiness (Ready for upscaling: Requires validation; Requires further research	Requires further research
G: Contacts	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO, E. Mutuma, P. Ketiem, J. Mwaura, A. O. Esilaba, J. Wamuongo
Partner organizations	County governments Public-Private-Partnerships

Research Gaps

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

2.5.16 TIMP name	**Drip irrigation systems for small scale farmers**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Increased crop water stress caused by seasonal rainfall variability in rain fed production. Inefficiency in water use for irrigation, this technology saves water
What is it? (TIMP description)  Layout of a drip irrigation system in vegetables	The technology that supplements water in crop production systems. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points (drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water

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
Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials • (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • e.g. SACDEP • 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	Makueni, Bomet, Kajiado, Machakos
Counties where TIMP will be promoted	All other Counties with suitable agro-ecological settings for Kale production.
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs. • High temperatures experienced in ASALs cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management
Recommendations for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water. • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of drip irrigation system
Lessons learned	• Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system 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	• Capacity building for increased awareness • Policy support for increased investments in Drip irrigation systems • The water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	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	• 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	• Women and youths have less access to credit required to install drip irrigation. • Women have less access to technology and information on the TIMP. • Women have less access to education, training and extension services.
Gender related opportunities	Employment opportunities exist for youths in installing the drip irrigation kits.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to credit required to install drip irrigation. • VMGs have less access to technology and information on the TIMP. • VMGs have less access to education, training and extension services.
VMG related opportunities	Employment opportunities exist for youths in installing the drip irrigation kits.
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** 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. 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)	1 =Ready for up-scaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; Fredrick Wanders

Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua- Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

Research gap

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

2.5.17 TIMP name	**Solar Irrigation for smallholder farmers**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	High cost of pumping water for irrigation, using electricity of fossil fuel powered pumps
What is it? (TIMP description)	This is the sole use of solar power in the pumping of irrigation water and running of the irrigation systems
Justification	There has been general increase in prices of diesel and electricity making pumping of irrigation water to be a costly operation. Though Solar panels have been used successfully to light houses and in small businesses in the rural areas, they have hardly been used in the irrigation systems despite their potential. With efforts in addressing climate smart agriculture focusing on renewable and green energy, solar power would be a good source of this, low cost and sustainable too
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material’s • Mobile phone

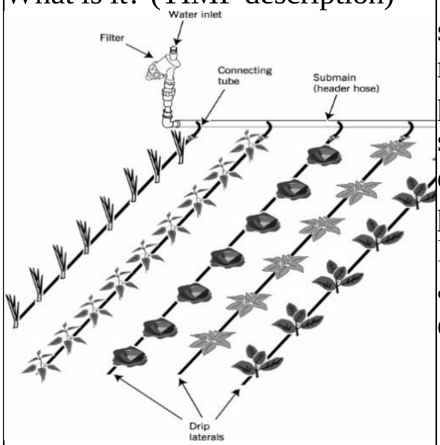
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Various counties including Marsabit, Garissa, Machakos, Nyeri, Kajiado, Siaya, Bomet, Kericho and Uasin Gishu
Counties where TIMP will be promoted	All the 24 KSAP counties
Challenges in dissemination	• Farmers lack knowledge on the potential of solar as a power source for irrigation systems • High cost of innovation
Suggestions for addressing the challenges	• Awareness trainings on different solar irrigation systems • Awareness creation on advantages of solar irrigation systems pumps to governments, farmers and development agencies. • Capacity building of extension workers • Developing information packages • Creating solar irrigation systems network
Lessons learned if any	Solar irrigation systems should be well designed in water delivery, storage and application to the field.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly, • Policies are friendly to the technology • Capable of increasing marketable products

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Higher investment costs but low operation costs. Costs depends on the energy required and size of irrigated area.
Estimated returns	Not yet done
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to land for kales cultivation than men. • Women and youth may also have limited access to finances to implement and operationalize the solar irrigation system. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	Employment opportunities exist for youth in installing the solar irrigation systems.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kales cultivation than men. • VMGs may also have limited access to finances to implement and operationalize the solar irrigation system. • VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Affirmative action in various areas as for instance in the provision of finances to VMGs. • Employment opportunities exist for youth in installing the solar irrigation systems.
E: Case studies/profiles of success stories	
Success stories	Solar irrigation systems success stories have been reported in counties such as Kajiado on high value crops.
Application guidelines for users	Manuals, Brochures, Factsheets and Leaflets
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further research	2 – Requires validation
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way,
	P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; IV Sijali, MPO Radiro, Francis Karanja, Fabian Kaburu
Partner organizations	Solar irrigation systems suppliers County governments

	National Irrigation Acceleration Programme (NIAP)

Research Gaps

- Validation of the solar irrigation systems in the different counties.
- Up scaling of the technology to smallholder community schemes
- Solar irrigation systems that maximizing crop water productivity

<table>
<tr><th>2.5.18 TIMP name</th><th>Drip irrigation systems for small scale farmers</th></tr>
<tr><td>Category (i.e. technology, innovation
or management practice)</td><td>Technology</td></tr>
<tr><td colspan="2">A: Description of the technology, innovation or management practice</td></tr>
<tr><td>Problem addressed</td><td>Increased crop water stress caused by seasonal rainfall variability in rainfed production.</td></tr>
<tr><td>What is it? (TIMP description)


Layout of a drip irrigation system in vegetables</td><td>The technology that supplements water in crop production systems. It allows the optimal usage of the limited water resource by dripping water slowly into the crop roots at low pressure through a number of emission points (drippers). Drip system saves water by minimizing evaporation losses and delivering water at the root zone where it is required. It also provides the opportunity for farmers to increase crop yields. It's easy to design and operated. The layout can either be above surface or buried below the surface. System provides efficient fertilizer usage (fertigation) with irrigation water</td></tr>
<tr><td>Justification</td><td>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</td></tr>
<tr><td colspan="2">B: Assessment of dissemination and scaling up/out approaches</td></tr>
<tr><td>Users of TIMP</td><td>Model Farmers</td></tr>
<tr><td>Approaches used in dissemination</td><td>• Kale Innovation Platforms
• Kale Farmer Field and Business Schools
• On farm and on station research trials and demonstrations
• Training workshops, Seminars, Meetings
• Field days
• Agricultural shows
• MoA/Extension officers
• Farmer research networks
• Farmer to farmer
• Mass media – Agricultural programs</td></tr>
</table>

	• Promotional materials • (posters/brochures/leaflets, manuals) • Web material's Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • e.g. SACDEP • 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	Makueni, Bomet, Kajiado, Machakos
Counties where TIMP will be promoted	High value crop production (e.g. tomatoes, vegetables, bananas) in Elgeyo Marakwet, Bomet, Kericho, Kajiado, Mandera, Siaya, Tharaka Nithi, Nyandarua, Nyeri, Kisumu, Busia, Taita Taveta, Machakos, Isiolo, Laikipia, Marsabit, Baringo and Garissa counties
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in ASALs. • High temperatures experienced in ASALs cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube • Limited knowledge on the drip irrigation technology and its management

Recommendations for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest on the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging free flow of water • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Intensive farmer training is required on the management of drip irrigation system
Lessons learned	• Drip system increases yield, incomes and food security • Linking farmers with markets is critical for enhancing sustainability • Covering the soil with organic matter (crop residue or green manures) in a drip system 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	• Capacity building for increased awareness • Policy support for increased investments in Drip irrigation systems • The water quality should be known to adjust the drip systems to avoid clogging
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	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	• 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	• Women and youths have less access to credit required to install drip irrigation. • Women have less access to technology and information on the TIMP. • Women have less access to education, training and extension services.
Gender related opportunities	Employment opportunities exist for youths in installing the drip irrigation kits.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to credit required to install drip irrigation. • VMGs have less access to technology and information on the TIMP. • VMGs have less access to education, training and extension services.

VMG related opportunities	Employment opportunities exist for youths in installing the drip irrigation kits.
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	Brochures, Leaflets, Manuals and factsheets **References** 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. FAO, 2014. Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers. Rome: Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/3/a- i3765e.pdf
F: Status of TIMP readiness (1. Ready for Upscaling; 2. Requires validation; 3. Requires further research)	1 – Ready for up-scaling
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; Fredrick Wandera
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua- Valley Services Ltd, Davis & Shirtliff, and many Micro finance institutions (MFIs)

GAPS

The impact of drip irrigation on economics of agriculture in the regions of adoption under study

Limited irrigation packages suited to small farmers - improved irrigation, agronomy, credit, technical support and assistance with marketing – to spur adoption.

2.5.19 TIMP name	**Hydroponics technology**
Category (i.e. technology, innovation or management practice)	Complementary technology
A: Description of the technology, innovation or management practice	
Problem addressed	Declining farming land area, irrigation water scarcity, environmental pollution and low food crop and fodder productivity.

What is it? (TIMP description)	Hydroponic farming is soilless farming system that utilizes inert media as an anchor to the crop and a rich nutrient solution applied for the growth of the plant. There are various systems used but the most famous is the vertical hydroponic system. This utilizes a small area and accommodates higher crop population than the conventional method of farming. Use of locally available soilless media such as pumice, coco peat contributes into the reduction of the cost of production such as weeding, water usage, soil analysis and more.
Justification	An upward swing in Increased food demand for ever expanding population inhabiting dwindling and fragmented land sizes is the current scenario in Kenya and poised to linger on for some while. Agricultural land has been converted into real estates, commercial and industrial parks thus posing a threat to sustainable food production. Implementation of alternative and intensive farming methods becomes inevitable due to increased rural urban migration in search of white collar jobs by the youth who are more than 60% of the Kenyan population. Conventional land use is gradually becoming untenable due to escalating change of land use in high agricultural potential areas. As estimated by the year 2050, in accordance with UNHABITAT reports, over 80% of the Kenya's population will be residing in urban areas. Food security will become unsustainable therefore, implementation of alternative farming method that could increase output and reduce environment impacts such as soil pollution caused by high use of chemicals for crop protection is the way to go. Vertical hydroponic farming is a suitable technology in urban areas where people live in apartments and with micro-plots for farming space. Likewise, in areas that are not endowed with natural resources such as arid and semi-arid lands. Hydroponics farming system does not require herbicides and pesticides that remains in the soil causing ill- health to humans, livestock and environment. To redress these challenges, adoption of hydroponics as an alternative farming methods will greatly boost food security.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Urban and peri-urban Farmers/youth
Approaches to be used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks

	• Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization e.g. SACDEP • 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	Kiambu, Nairobi, Nakuru, Kakamega
Counties where TIMP will be promoted	Kajiado, Tharaka Nithi, Machakos, Kitui, Laikipia, Marsabit, Taita Taveta
Challenges in dissemination	• Labour and expertise needed • Culture change of mind-set in some regions/cultures that the rich nutrient solution cannot support crops growth without soil. • Initial cost implications
Suggestions for addressing the challenges	• Awareness trainings on role of hydroponics in crop and fodder production. • Training and awareness crop and fodder intensification on small areas and short production span • Excursion training or exchange visits-- see and belief
Lessons learned if any	• For hydroponics to succeed, mind-set has to change, quality of planting materials and media and the hydroponic support structurally sound.

Social, environmental, policy and market conditions necessary	• Practice is socially acceptable, • Environmentally friendly , since this is soilless farming • Increased productivity, maximizing profits in small area. • In season and out season marketing
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a technically labour friendly and low cost - Gender, vulnerable and marginalized groups
Estimated returns	Farmers who have adopted Hydroponics technologies have realized high returns due to reduction of production and high yield in a short production cycle. But the economic costs have not been calculated
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to land for kale cultivation than men • Women and youth may also have limited access to finances to implement and operationalize the technology • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Employment opportunities exist for youth in installing the technology
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men • VMGs may also have limited access to finances to implement and operationalize the technology • VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Employment opportunities exist for youth in installing the technology • Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production will lead to increased consumption and utilization of kaless and hence improved health of VMGs
E: Case studies/profiles of success stories	
Success stories	Hydroponics technologies successes have been reported in fodder and vegetables production in Muguga, Limuru –Kiambu county.
Application guidelines for users	Brochures, Leaflets, Manuals & Fact sheets
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

Lead organization and scientists	KALRO; E. Muriuki, F. Kaburu, David Kamau, IV Sijali.
Partner organizations	County governments Ministry of Agriculture, Livestock, Fisheries & Irrigation World Vision

Research Gaps

- Validation of the hydroponics technology in Counties where technology has not been tested.
- Testing with different value chains, feed and food.

2.5.20 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)	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	Given the acute poverty and limited access to mineral fertilizers in most rural farmers in Kenya, this promising approach is one that integrates organic and inorganic fertilizers. Organic fertilizers include the use of improved fallows of leguminous trees, shrubs, herbaceous legumes and biomass transfer. Moreover, continuous land operation continues to emit more GHGs (carbon) responsible for the climatic changes. Agroforestry with leguminous trees has potential to increase the productivity improving soil structure and protect the soil against erosion and nutrient losses by maintaining a permanent soil cover and inimizing soil disturbance, Conserve soil water, Enhance nutrient cycling and enhancing biodiversity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

Approaches used in dissemination	• Kale Innovation Platforms • Kale Farmer Field and Business Schools • On farm and on station research trials and demonstrations • Training workshops, Seminars, Meetings • Field days • Agricultural shows • MoA/Extension officers • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials • (posters/brochures/leaflets, manuals) • Web material's • Mobile phone
Critical/essential factors for successful promotion	• Applied and adaptive research to release and validate Kale Soil & water management practices • Mechanism for interaction of Kale value chain stakeholders • Well organized farmer groups and networks • Good Marketing Models and path ways • County and central government support • Funding to research, validate and promote new Kale technologies • Collaboration between all partners and stakeholders • Adequate facilitation
Partners/stakeholders for scaling up and their roles	• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations • Market players to create a demand and pull production • Farmers/farmer groups to adopt and produce • County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination • NGOs for farmer organizing and mobilization • e.g. SACDEP • 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	Machakos, Siaya, Kisumu, Kakamega, Busia, Tharaka Nithi,
Counties where the TIMP will be up-scaled	All 24 KCSAP counties

Challenges in dissemination	• 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
Recommendations for addressing the challenges	• 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 • Availing inputs and credit • Allocation of more funds for continued research and dissemination of this technology would aid • increased uptake agroforestry for soil fertility
Lessons learned	• 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	• Reliable technology adoption and suitable price and market access for produce grown under the improved • agroforestry system
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 ,dissemination, adoption and scaling up	• Women and youth have limited access to land for kale cultivation than men • Women and youth may also have limited access to finances to implement and operationalize the technology • Women have less access to agricultural information, technology and knowledge than men
Gender related opportunities	Employment opportunities exist for youth in installing the technology
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to land for kale cultivation than men • VMGs may also have limited access to finances to implement and operationalize the technology • VMGs have less access to agricultural information, technology and knowledge than men
VMG related opportunities	• Employment opportunities exist for youth in installing the technology • Affirmative action in various areas as for instance in the provision of finances to VMG

	• Increased production will lead to increased consumption and utilization of kaless and hence improved health of VMGs
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	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	2- Requires validation
G: Contacts	
Contacts	Kenya Forestry Research Institute, P.O. Box 20412, Nairobi jkndufa@gmail.com +254 722 983238
Lead organization and scientists	KEFRI and KALRO, J. Ndufa, M. Okoti; E. Odoyo, B. Mugo
Partner organizations	County government, Private Public Partnerships

Gaps

1. Validation of existing technologies in different agro-ecological zones/counties

2.6 KALE CROP HEALTH

2.6.1 TIMP name	**Scouting in Pest and Diseases Identification and Management**  Looking on the underside of leaves for pests during scouting Source: KALRO

	 Scouting procedure (GAP Manual)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Increased incidences of pest infestation on many crops due to limited awareness by farmers on the need to carry out scouting for pest attack in their fields.
What is it? (TIMP description)	Scouting techniques and frequency to determine the presence of the different types of pests and their respective populations in order to make a decision on what the control measures to be undertaken. Scouting involves regular monitoring the incidences of pest damage to crops. The purpose is to gain a good understanding of insect pests, diseases, weed and beneficial insect activities in your crop. Effective monitoring includes assessing the numbers of insect pests as well as the beneficial insects in a crop together with the incidences of diseases and weeds. Recording this information and any control actions taken, will help to better understand your crop management practices over time. Scouting has to be done on a regular basis so that appropriate remedial measures are undertaken timely hence reducing crop losses as well as saving on the costs of pesticides. **Scouting Procedure** • Get into the farm and take a closer look • In a large farm, divide it into blocks and walk in a defined pattern (z, v, w or zigzag) • Look at leaves and turn them over (damp areas have insects and disease) • Scout as often before they get out of control • Get into the farm and take a closer look

	• In a large farm, divide it into blocks and walk in a defined pattern (z, v, w or zigzag) • Look at leaves and turn them over (damp areas have insects and disease) • Scout as often before they get out of control
Justification	Most farmers spray pesticides indiscriminately in the kale crop. This is not only uneconomical but also destructive to the environment and at the same time kills the beneficial insects. Timely scouting is very critical in implementing the correct management strategies.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Researchers, Academia, Environmentalists, County governments, Input suppliers and Policy makers
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of cassava value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects

Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be upscaled	All other Counties with suitable agro-ecological settings for kale production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective

	production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Presence of a functional seed system • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately Ksh 200 per day for 3 months (12 days per month)
Estimated returns	KES 100,000-200,000 per acre per year based on variety and period of harvest

Gender issues and concerns in development, dissemination adoption and scaling up,	• Women and youth have limited access to productive resources such as credit to purchase the regured inputs such as chemicals than men • Women and youth have limited access to education, training and extension services than men • Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	• Opportunities for youths exists in spraying the crop
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to seed and information on new varieties and production techniques • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by

	Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9 (1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling.
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gap

1. Development of surveillance software systems for monitoring pests in cabbage fields.

2.6.2 TIMP name	**Integrated Management of Diamond back moth (*Plutella xylostella*)**   **Diamond back moth agric.wa.gov.au)** **Diamond back moth (Source: (Source: Lusike Wasilwa KALRO)**

<table>
<tr><td>Category (i.e. technology, innovation or management practice)</td><td>Management practices</td></tr>
<tr><td colspan="2">A: Description of the technology, innovation or management practice</td></tr>
<tr><td>Problem addressed</td><td>Up to 30-50% yield loss i experienced on kale due to diamond back infestation. This pest also affects Kale by lowering yields and compromising quality</td></tr>
<tr><td>What is it? (TIMP description)</td><td>Integrating control measures including cultural practices, biopesticides, biological control and soft pesticides that are used in controlling the Diamond back moth which affects Kale by lowering yields and compromising quality.

Cultural methods
Scouting of fields; starting off with healthy clean seedlings free of caterpillars
Remove and destroy or plough down crop residues in seedling beds and production fields
practice crop rotation for a period of at least 6-8 weeks and ensure that the young crop is not planted next to an older crop
weed fields since some weeds in the Kale family could serve as alternative hosts and harbour the pest season after season;
Intercrop kale with chillies as these repel adult moths
Pick caterpillars and crush them
Use of pheromone traps
when the diamondback moth is present in low numbers may preserve natural enemies that can help keep diamondback moth and aphid populations under control later in the season
Biological Control
Use biopesticides e.g Bacillus thuringiensis (BT based sprays) e.g Baciguard 16 WDG, Bio-T-Plus, Biokill WP
Use of neem based biopesticides e.g Nimbecidine, Neemroc 0.03% and Achook 0.15%.
Chemical control
Spray using spinetoram (Radiant 120 SC (R)) at the rate of 18-30ml/20litre of water or deltamethrin, carbaryl, bacillus thuringiensis, spinosad, bifenthrin, Indoxacarb, pyrethrin, methomyl and novaluron. Always adhere to the recommended rates and observe the Pre-Harvest Intervals on the product label.</td></tr>
</table>

Justification	The diamond back moth causes losses in Kale and compromises quality by feeding on the leaves and creating holes. Where the pest is severe and not controlled losses of 30-50% may be observed with 100% of leaves punctured. Marketing of produce that is severely affected poses challenges and fetches low prices. Integrated Management of pests considering food safety should be highly advocated in Kales considering that the vegetable is consumed widely in Kenya. This involves the use of a combination of cultural and biocontrol methods and biopesticides that are relatively safe. 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, Researchers, Academia, CGIAR', Environmentalists, County governments, Input suppliers and Policy makers
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of Kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /extension/companies producing biologicals and biopesticides and farmers would enhanvce promotion.

Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted in some parts of Kiambu, Kirinyaga,Embu, Meru, Nakuru Counties.
Counties where TIMPs will be upscaled	All other counties producing Kale
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Presence of a functional seed system • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms

Social, environmental, policy and market conditions necessary for developing and upscaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 10,000-20,000 per acre per season
Estimated returns	KES 100,000-200,000 per acre per year based on variety and period of harvest
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and farm inputs men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-

Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling; 2-Validation in some areas
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

- Explore bio-control options for management of diamond back moth
- Explore the efficacy of bio-pesticides and ITKs in pest management at different stages of the diamond back moth pest
- Validation of tolerance of new varieties to pests

2.6.3 TIMP name	Integrated Management of Aphids *Brevicoryne brassicae*)
	 **Aphids** (Source: Lusike Wasilwa KALRO)
Category (i.e. technology, innovation or management practice)	Management practices
A: Description of the technology, innovation or management practice	
Problem addressed	Yeild loss of 30-70% and lowering of the quality of Kales.
What is it? (TIMP description)	This is the integrated use of cultural, biopesticides and synthetic insecticides where the pest is very severe, to control aphids which affect Kale by lowering yields and compromising quality. This are; **Cultural methods** • Scouting of fields twice weekly, looking under the leaves and bud areas for aphids • Start off with healthy clean seedlings free of aphids or their eggs • Remove and destroy or plough down crop residues in seedling beds and production fields • Practice crop rotation for a period of at least 6-8 weeks and ensure that the young crop is not planted next to an older crop • Weed fields since some weeds in the Kale family could serve as alternative hosts and harbour the pest season after season • Intercrop with chives, garlic, kaless, radish, or parsley which are good repellants of aphids • When the aphids are present in low numbers preserve natural enemies e.g lace wings, ladybird wings, hover flies. **Biological Control** • Use neem based products e.g Nimbecidine, Neemroc 0.03% and Achook 0.15%. • Use of traps to attract winged adults.

Justification	Aphids cause losses in Kale and compromise quality by piercing and sucking sap from the leaves. Where the pest is severe and not controlled plants shrivel due to the sap sucking effect, become greatly reduced in size and dull in color. Losses of above 30-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently Kale farmers use a lot of synthetic pesticides in controlling aphids. Integrated Management of pests considering food safety concerns should be highly advocated in Kales considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and biocontrol methods and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. 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, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /

	extension/companies producing biologicals and biopesticides and farmers would enhanvce promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted in some parts of Kiambu, Kirinyaga, Embu, and Meru Counties.
Counties where TIMPs will be upscaled	Target KCSAP Counties and all other counties producing Kale
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Presence of a functional seed system • Adoption of good agricultural practices by farmers is key in management of the insects

	• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	These costs may be estimated at KES 10,000 -20,000 per acre per year.
Estimated returns	KES 150,000-200,000 per acre per year depending on variety due to reduction of losses resulting from aphid infestation.
Gender issues and concerns in development,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and farm inputs men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng,

	Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for up scaling; 2-Validation in some areas
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

Explore bio-control options for controlling the aphids to minimize on pesticide use Explore the efficacy of ITKs in management of aphids under high pressure Validation of tolerance of new varieties to aphids

2.6.4 TIMP name	**Use of Traps in Management of Aphids (*Brevicoryne brassicae*)**

	a)   b)  c) **Yellow aphid traps** **Source a) vicaspedia.in b) research gate.net c) KALRO**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to crop damage by the pest.
What is it? (TIMP description)	This is part of intergrated management of aphids in kale using traps. • Place 1-4 sticky cards per 300 sq m field area • These traps should be replaced at least once a week. • To make your own sticky trap, spread petroleum jelly or used motor oil on yellow plywood, 6 cm x 15 cm in size or up. Place traps near the plants but faraway enough to prevent the leaves from sticking to the board. • Traps should be hunged positioned 61 cm zone above the plants. • Basin/pan traps can also be used by half-filling yellow pan or basin with soapy water and placing the pan/basin close to the plant but exposed enough so that aphids can see it.
Justification	Aphids (*Brevicoryne brassicae*) feed on the plant and result into stunted growth, premature death of plants and poor yields. Use of traps has been found to be very effective in lowering the aphid population in areas where they have been used. Traps are also environmentally friendly and not very expensive for our resourse poor farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension Agents (Public and Private), eRsearch organizations and Universities, CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer

	• Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel / Extension /companies producing biologicals and biopesticides and farmers would enhanvce promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	

Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho.
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of farmers in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if Any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5000-15,000 on traps per year/acre
Estimated returns	KES 98,000-200,000 with over 90% control of the pest
Gender issues and concerns in development, dissemination	• Women and youth have limited access to purchase the required traps than men.

adoption and scaling up,	• Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities exist for for youths in making and selling the traps.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to buy the required traps. • VMGs have limited access to training and extension services. • VMGs may have limited access to knowedge and information on technologies such as traps. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths and those recovering from drugs exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling (Use of insect predators), 2-Requires validation (Use of plant extracts/botanicals) 3-Requires further research (Use of Ammonia and Soap solutions),
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**

Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

Assess the efficacy of using traps under different levels of pest infestation

2.6.5 TIMP name	**Integrated Management of Soil pests (Cut worms, *Agrotis* spp and Cabbage root maggot (*Delia radicum*))**  **Cutworm** Source: Infonet biovision
Category (i.e. technology,	Management practice
innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to crop damage.

What is it? (TIMP description)	Integrated management of soil pests involves the use of a combination of biological, cultural, and chemical control methods in kale fields. **Cultural methods** • Weed the field at least two weeks prior to planting • Pick and crash the larvae • Scratch the soil near plants to expose the pest • Place a stick near the stem to deter the pest from attacking the plant **Bio-control** • Use a b**io-pesticides** *Bacillus thuringiensis* (BT) at recommended rate • Use 5% Malathion dust, dipterex trichorphon 5% dust at 2 kg/ha and add baits such as bran mixed with sugar around the plant after transplanting or spray using pyrethroid based insecticides (Brigade, Sevin, Fastac or Karate).
Justification	Cutworms normally cut the seedlings stem at the soil line, and eat holes into roots. The injured plant thereafter, withers and dies. Young caterpillars feed on the leaves leaving perforations on the leaves. The pests feed on the plants at the base causing serious damage to stems. Stalks of plants may be cut. Integrated Management of the pests using cultural, biological as well as chemical options is critical to ensure optimum plant population and to achieve expected yields.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, extension Agents (Public and Private), Research organizations and Universities, CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals

Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel / Extension /companies producing biologicals and biopesticides and farmers would enhanvce promotion. •
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho.
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Cabbage production.

Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 10,000-20,000 per acre/year
Estimated returns	KES 100,000-200,000 per acre/year
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and farm inputs men. • Women and youth have limited access to education, training and extension services than

	men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	2- Requires validation (Use of botanicals/plant extracts).
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**

Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

Explore efficacy of bio-control options for soil borne pests Explore the efficacy of ITKs in management of soil borne pests Validation of tolerance of new varieties to soil borne pests

2.6.6 TIMP name	**Integrated management of Cabbage web worm (*Hellula undalis*)**  **Cabbage webworm** Source: Infonet biovision
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice; Management practice	
Problem addressed	Yield loss of up to 80% and quality reduction due to infestation and damage of crop.

What is it? (TIMP description)	This is intergrated management of web worm in kale by application of a various options (cultural, biopesticides and soft safer synthetic chemical). **Cultural** The cultural management practices include; Eearly planting, • Use of trap crops like mustard in strips • Destroy infestedplants by burying 2ft deep before planting Kales, • Encourage natural enemies • Removal of weeds that may serve as alternate hosts • Practice crop rotation with non-cruciferous crops and cut off webbed leaves and kill the caterpillars inside. **Biological control** Use of neem based biopesticides e.g Nimbecidine, Achook 0.15%, and Neemroc 0.03% **Chemical control** Apply relatively safe/soft pesticides such as PYNEEM 20EC if attack severity is high.
Justification	Insect pests are a major challenge in kale production and it is attributed to farmers using infected kale from the previous season's crop. Farmers do not know how to manage insect pests affecting kale. Integrated management options will provide farmers with a basket of management options that they can use to manage the cabbage web worm infestation on kale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's

	• Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel / Extension /companies producing biologicals and biopesticides and farmers would enhanvce promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.

	• Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Presence of a functional seed system • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms

Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 5,000-10,000 per year
Estimated returns	KES 98,000 -200,000 per year based on variety grown and period of harvesting
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and farm inputs men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwse Knowledge Bank

	• Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling (Use of insect predators), 2-Requires validation (Use of plant extracts/botanicals)
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

1. Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management
2. Lack of facilities for quick diagnosis of the pests in most counties
3. Evaluate new Kale varieties for tolerance to cabbage webworm

2.6.7 TIMP name	**Integrated Management of Cabbage Sawfly (*Athalia sjostedti*) and cabbage looper (*Trichoplusia ni*)**  **Cabbage sawfly (Source: infonet biovision)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to crop damage by the pest.
What is it? (TIMP description)	Integrated management practices for cabbage sawfly on kale are as follows; Cultural • Removal and destruction of all plant debris after harvest to kill pupae, • Handpick and destroy of larvae • Encourage the multiplication of natural enemies (ladybird beetles, hover fly larvae, lacewings, spiders, damsel bugs, ground beetles, rove beetles and, wasps) • Place1-4 sticky cards per 300 sq m field area to control cabbage sawfly. These traps should be replaced at least once a week. To make your own sticky trap, spread petroleum jelly or used motor oil on yellow plywood, 6 cm x 15 cm in size or up. Place traps near the plants but faraway enough to prevent the leaves from sticking to the board. Traps should be positioned 61 cm zone above the plants. **Biological control** • Use bio-pesticides such as *Bacillus thuringiensis* (B.t.), nuclear polyhedrosis (NPV) *Metarhizium anisopliae*, neem and insect growth regulators such as Match. **Chemical control** • Spray using spinetoram (Radiant 120 SC [R]) at the rate of 18-30ml per 20 L of water or deltamethrin, carbaryl, bacillus thuringiensis, spinosad, bifenthrin,

	Indoxacarb, pyrethrin, methomyl and novaluron. Always adhere to the recommended rates and observe the Pre-Harvest Intervals on the product label.
Justification	Insect pests are a major challenge in kale production and it is attributed to farmers using infected kale from the previous season's crop. Farmers do not know how to manage insect pests affecting kale. Integrated management options will provide farmers with a basket of management options that they can use to manage the cabbage sawfly infestation on kale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension agents (Public and Private), Research organizations and Universities, CGIAR
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel / Extension /companies producing biologicals and biopesticides and farmers would enhanvce promotion.

Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Kiambu, Meru, Nyeri, Nyandarua, Bomet, Nakuru and Kericho
Counties where TIMPs will be upscaled	All counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Presence of a functional seed system

	• Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES. 10,000-20, 000 per acre/year
Estimated returns	KES. 98, 000 to 200,000 per acre depending on variety and length of harvesting per year
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and farm inputs men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exists in spraying the crop.

E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling (Use of insect predators). 3-Requires validation (Use of plant extracts/botanicals)
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management

Lack of facilities for quick diagnosis of pests in most counties

Evaluate new Kale varieties for tolerance to cabbage sawfly and cabbage looper

2.6.8 TIMP name	**Integrated Management of Thrips (*Frankliniella* spp.)**  **Thrips** (Source: Infonet biovision)  **Thrips damage** (Source: SJN Muriuki. KALRO)
Category (i.e. technology, innovation or management practice)	Management practices
A: Description of the technology, innovation or management practice	
Problem addressed	Loss of yields and lowering of quality of Kales.
What is it? (TIMP description)	**Cultural Control** • Maintain a healthy crop as it will tolerate thrips and keep the field weed free • Avoid planting new crop near an existing infected field • Mulch fields as this helps reduce thrips population • Use overhead irrigation where possible to reduce spread of thrips • Remove and destroy volunteer plants and debris that may harbour thrips • Uproot heavily infested plant material and burn • Apply soapy sprays (mix 5 teaspoon full of soap powder or chopped bar soap with cold water and dissolve and spray on the infested plants • Use blue sticky cardboard traps to attract thrips. Use synthetic insecticides with PHI of 3 days or less since Kale is harvesting at very short intervals. **Biological control** • Apply biocontrol agents e.g Beauvitech WP (Beauveria bassiana) or Bio-Power 1.5L (Beauveria bassiana), or Botanigard ES (Azadirachtin), • Spray neem based products like neemroc EC and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water). **Chemical Control** • Spray with Spinosad based products eg tracer 480 SC at 4mls per 20lts of water or lambda cyhalothrin products at 7ml per 20l of water or duduthrin at 65mls per 20l of water or Karate at 20gms/ 20l
Justification	Thrips cause losses in Kale and compromise quality by

	.Currently Kale farmers use a lot of synthetic pesticides in controlling thrips. Integrated Management of pests considering food safety concerns should be highly advocated in Kales considering that the vegetable is consumed very widely in Kenya and farmers harvest almost daily. This involves the use of a combination of cultural and biocontrol methods and biopesticides that are relatively safe. This minimizes greatly on synthetic pesticides that may raise health concerns. Sensitization of farmers and their 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, Bio-pesticide / biological Companies, CGIAR's
Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures Conferences and journals
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biological controls • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel / Extension /companies producing biologicals and biopesticides and farmers would enhanvce promotion.

Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted in some parts of Kiambu County.
Counties where TIMPs will be upscaled	Target KCSAP Counties and all other counties producing Kale
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Presence of a functional seed system • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms

Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Funds for blue traps, bio-pesticides and biological control products is a pre-requisite for incorporating some of the control practices as part of the IPM strategy Costs per acre range between KES 10,000-20,000 per year
Estimated returns	Reduce infestation by over 80%, hence approaching maximum potential production per acre (about KES 98,000- 200,000 returns per acre achieved if the farmer grows a variety that can be harvested over several seasons and applies management practices
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and farm inputs men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit, 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. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa,

	Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for up scaling; 2-Validation in some areas
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner Organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

Train Extension staff as Plant Doctors and Lead farmers as Plant Nurses to assist farmers in pest and disease diagnosis and management

Lack of facilities for quick diagnosis of the pest in

most counties Evaluate new Kale varieties for

tolerance to thrips

2.6.9 TIMP name	**Use of Natural Enemies (Parasitoids) for Management of Diamondback Moth on Kale.**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem addressed	Low yield in Kale production systems
What is it? (TIMP description)	This is a biological control method for management of Diamond back moth on crucifers. The method uses larval parasitoids of diamond back moth to break the pest's life cycle thus reduce its population in Kale fields. This technology is suited for mid- and high-altitude areas and is self-replicating to large areas with similar environmental conditions. It is based on importation and release of exotic parasitoids for the pest. A parasitoid for highland growing conditions, *Diadegma semiclausum*, was introduced from Taiwan and released in Kenya, whereas for the semi-arid areas *Cotesia plutellae* (Kurdjumov) from South Africa was introduced and released in the low lands of Kenya.
Justification	The Diamondback moth is considered an economically significant pest in Cabbage production zones due to its frequent infestation hence, increased production costs and reduction in cabbage yields. The parasitoids have shown need for pesticide use in crucifer production highly reduced (KES.13, 068/ha to KES.4,686/ha). Farmers and the environment have been protected against side effect of pesticides. Financial benefit to farmers has also increased (Av.5t/acre to 8.1t/ha) yield. The eco-friendly pest control technology is easy to apply by both men and women and is widely accepted by farmers. It is compatible with other IPM options and contributes to safe produce that meets consumer preference both in the local and regional markets. This technology is environmentally friendly and it is suitable substitute for synthetic pesticides. The use of synthetic pesticides often leads to serious environmental problems besides affecting the health of users and consumers. Pesticides also eliminate the natural enemies of diamond back moth, creating the need for more pesticides, increasing production costs, and leading to the development of insecticide resistance.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers, Extension service providers, agro-dealers.

Approaches to be used in dissemination	• On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals.
Critical/essential factors for successful promotion	• Support Agro chemical companies to sell biopesticides • Create awareness of the benefits of the biopesticides • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate use of parasitoids in management of insects • Create a platform for interaction of kale value chain stakeholders • Farmers adopt appropriate agronomic practices • A strong partnership between technical personnel / Extension /companies producing biologicals and biopesticides and farmers would enhanvce promotion.
Partners/stakeholders for scaling up and their roles	• Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of biopesticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in

	agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	All other Counties with suitable agro-ecological settings for Cabbage production.
Challenges in dissemination	• Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting kale and losses attributed to them • Poor linkages among stakeholders in kale value chain
Suggestions for addressing the challenges	• PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish kale innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing • Enhancing participatory technology development at on-farm level • Capacity building and sensitization forums on the effectiveness of this technology in promoting food and environmental safety. • Strengthened public-private partnerships
Lessons learned in up scaling, if any	• Sensitization is necessary for people to appreciate the use of IPM in pest management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms

Social, environmental, policy and market conditions necessary for development and up scaling	• Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure biopesticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(KES.5,227.2/acre to KES.874.4/acre).
Estimated returns	Reduce infestation by over 80% (Av. 11.36t/acre to 13.24t/acre).
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in rearing the natural enemies.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to training and extension services than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on the biological control techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths in rearing the natural enemies.
E: Case studies/profiles of success stories	
Success stories	• Natural release areas in major cabbage growing areas established. • Biological control of DBM using parasitoid wasp *Diadegma semiclausum* has proven very effective in the highlands of Kenya, • The parasitoids have shown Need for pesticide use in Cabbage production highly reduced from (KES.13, 068/ha to KES.4,686/ha), • Farmers and environment protected against side effect of pesticides,

Application guidelines for users	• CABI-Plantwse Knowledge Bank • Cabbage Cultivation Manual. 2016. Vincent Ochieng, Victor Wasike, Isaya Sijali, Miriam Otipa, Bosibori Bett, Samuel Njihia, Christine Gitonga, Jackson Wamalwa, Charles Ndiege, Elizabeth Odoyo, Abel Too, Ruth Amata, Agnes Ndengwa, Francis Wayua. ISBN NO: 978-9966-30-030-0 .Volume 1. • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (e.g. 1-Ready for upscaling, 2-requires	2. Requires validation.
G: Contacts	
Contacts	The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya**.** **Email: fcrc.muguga@kalro.org** **Tel: +254-0722219075**
Lead organization and scientists	**KALRO:** Ruth Amata; Miriam Otipa, Fredrick Wandera, Anthony Nyaga, Harun Odhiambo, Anastacia. Masinde, Vincent Ochieng, Charity Gathambiri; Eliezer Kamau, Lusike Wasilwa **CABI:** Duncan Chacha **UON:** George Ongamo
Partner organizations	CABI, ICIPE, Real IPM, Koppert, Universities, County governments

Research Gaps

The management strategy requires validation in various Kale growing areas to ascertain performance under high pressure of the diamond back moth pest

2.6.10 TIMP name	Integrated Management of damping off disease in Kales  **Damping off disease affecting crucifers (Source: Igpress.clemson.edu)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to due to damping off disease
What is it? (TIMP description)	Integrated management package for damping off disease of Kales includes identifying a nursery site that is free from soil borne diseases. For high rainfall areas, prepare raised nursery beds to avoid water logging, for moderate rainfall areas, flat nurseries would be suitable, for low rainfall areas sunken beds are recommended to conserve water. Solarize nursery beds by exposing them to the hot sun during hot weather to destroy fungal structures in the soil. Solarization may be enhanced using a plastic sheet to increase temperature build up in the nursery beds. Avoid waterlogging as these favours pathogens (especially *Rhizoctonia* spp. *Pythium* spp. *Phytophthora* spp.) which cause nursery diseases. Monitor the nursery for disease symptoms for timely management. Practise hygiene, disinfecting farm tools in jik solution (50ml: litre) to prevent spread. Use Trichoderma based biocontrol agents including Rootgard, Trichotech, Trianum-P or Eco-T. Where disease is severe cabendazim products e.g Bendazim 500SC, Rodazim SC and Propamocarb hydrochloride and Fosetyl aluminium based products e.g Previcur may be drenched in the soil at nursery level.

Justification	Damping off disease is a major challenge when starting off seedlings in nurseries in Kale production in Kenya. Pathogens that cause this disease, including *Rhizoctonia* spp. *Pythium* spp. *Phytophthora* spp and *Fusarium* spp occur in all major production areas. Failure to observe rotation of nursery sites and prevention of water logging may contribute to the severity of the disease which causes rotting at the soil line and the lower part of the seedling stem. Losses of 90- 100% have been experienced in nurseries where waterlogging is a problem. It causes production of weak seedlings that may transfer the disease to the field and lead to increased costs of management. An integrated disease management approach is enables the control of the disease through recommended cultural practises with create unfavourable conditions for the soil borne pathogens at nursery level.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages. - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted.

Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination. - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments-Help in the dissemination of the IDM package
C: Current situation and future scaling up	
Counties where already promoted, if any	The management practices have been promoted to Kale and cabbage farmers across the country
Counties where TIMPs will be up-scaled	KCSAP target Counties and other regions where Kale is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (soil testing, use of clean seedlings, field sanitation, rotation of nursery sites, biological control using *Trichoderma* based products in managing the disease at nursery level
Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the synthetic chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	- KES 5,000-10,000
Estimated returns	- KES 98,000-200,000 per acre/year depending on variety and harvesting period
Gender issues and concerns in development, dissemination adoption and scaling up,	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities exist for unemployed youths in the management of damping off disease in kales.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to information on production techniques • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities exist for unemployed youths in the management of damping off disease in kales.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications to be developed
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)- Anthony Nyaga KALRO (HRI Kandara)-Charity Gathambiri KALRO (ICRI Sericulture)- Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; Charity Gathambiri CABI-Duncan Chacha

	KALRO (FCRC Kitale)- Dr. Japheth Wanyama KALRO (Headquarters)-Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - CGIAR's - NGOs
	- County governments

Research Gaps

Explore the efficiency of using biocontrol agents and solarisation in management of various fungal soil borne pathogens at nursery level

2.6.11 TIMP name	**Integrated Management of powdery mildew (*Erysiphe cruciferarum*) disease of Kales**  **Powdery mildew affecting Kale leaves** (Source; Ruth Amata KALRO)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem addressed	Yield loss due to disease
What is it? (TIMP description)	For powdery mildew disease, the integrated management package involves scouting for the disease, use of ITK's; Spray using solution comprising of 1 teaspoon of bakingsoda in 1litre water before disease becomes severe, cultural practices including appropriate spacing to reduce overcrowding which creates a microclimate and enhances disease spread, cultural control involves rotation of Kale with non-brassica crops for 2-3 seasons, field hygiene and use of disease free seedlings. Kale varieties will be validated and up-scaled for their relative tolerance/resistance to powdery mildew in respective counties. Use of biological control products e.g Biodewcon. Chemical control involving use of recommended registered safe soft fungicides (WHO Class 111) e.g azoxystrobin based (Maxidor) and Iprodione based (Iprode 500) with 2-3 days PHI levels. New varieties will be assessed for tolerance to powdery mildew and the favourable varieties per region upscaled.
Justification	Powdery mildew disease is a major challenge in Kale production in Kenya, occurring in all production areas. The disease is severe because the pathogen produces abundant spores which cover leaves reducing the plants photosynthetic area. This causes significant yield loss both in terms of quantity and quality. Where the disease is not controlled and under favourable conditions losses ranging 30-70% have been reported. Even where the crop is not totally wiped out it is un-marketable. Integrated Disease Management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety considering that the Kale crop is consumed widely in large quantities among the Kenyan communities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's

Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Need for farmer involvement helps generate locallyspecific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. - Accessibility and cost of the practice to farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted to farmers mainly in Central region of Kenya
Counties where TIMPs will be upscaled	KCSAP target Counties and other regions where Kale is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean disease free seedlings, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer

	communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kales
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Funds for bio-pesticides and biological control products is a pre-requisite for incorporating some of the control practices as part of the IPM strategy Basuc costs of about KES 10,000-20,000 per year
Estimated returns	- Management of powdery mildew would reduce losses by up to 80% where control measures are applied - KES 98,000-200,000 estimated returns per year depending on variety and harvesting period
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	• Opportunities for unemployed youths exist in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications and fact sheets developed
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires	1-Some of the management options are ready for upscaling 2-Some management options require validation e.g the tolerance of new varieties to pests and diseases needs to be
further research)	established across counties
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)- Anthony Nyaga KALRO (HRI Kandara)-Charity Gathambiri KALRO (ICRI Sericulture)- Eliud Gatambia KALRO (HRI Kandara)- Eliezer Kamau; CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama KALRO (Headquarters)-Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps

Explore the efficacy of bio-control options for powdery mildew disease in various AEZ's Explore the use of ITKs in disease management at different stages of the disease Validation of tolerance of new varieties to powdery mildew in various growing regions

2.6.12 TIMP name	**Integrated Management of black rot (*Xanthomonas campestris pv campestris*) of Kale**  **Black rot disease of crucifers** (Source; Ruth Amata KALRO)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease
What is it? (TIMP description)	For black rot disease of Kales, the management package involves scouting for the disease, cultural practises including crop rotation with non-brassica crops such as maize and beans, for a period of 3-4 years, rogueing out infected plants from the farm and burying, Avoidance of working in the fields when plants are wet to minimize spread, disinfecting farm tools in jik solution (50ml: litre). New Kale varieties will be validated and up-scaled for their relative tolerance/resistance to black rot in respective counties. Use of various copper based fungicides which are soft/safe synthetic pesticides will be validated for their usefulness in protective control of the disease.
Justification	Black rot disease is a major challenge in Kale production in Kenya, occurring in all major production areas. It causes significant yield loss because it causes death of tissues, hence disabling the ability of the plant to photosynthesize. Losses 70-100% have been experienced where the pathogen was soilborne at planting. Integrated Disease Management is an environmental friendly approach that enables the control of the disease and cultural practises that prevent on farm spreadhence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages between research institutions, extension and farmers Need for farmer involvement helps generate locallyspecific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Information can be promoted and adopted faster. Accessibility and cost of the practice by farmers: low cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments to help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	KCSAP target counties and other regions where Kales are grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on alternative integrated disease management practices (use of clean seed, field sanitation and tolerant varieties) in managing the disease.

Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the synthetic chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological rinciples.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kales
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Costs are minimized when using IDM since the cultural practices are mostly affordable Basic costs KES 10,000- 20,000
Estimated returns	- About KES 98,000-200,000 per year based on variety and period of harvest
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production

	techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exist in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications not yet developed
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	1-Ready for upscaling, 2-requires validation, 3-requires further research)
Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (HRI Kandara)-Charity Gathambiri KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama KALRO (Headquarters)-Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - FAO - NGOs - County governments

Research Gaps

Explore use of Bio-control options for black rot disease Evaluate new Kale varieties for tolerance to black rot disease

2.6.13 TIMP name	**Integrated Management of leaf spot (*Alternaria* sp and *Mycosphaerella brassicicola*) diseases of Kales**  **Leaf spots affecting Kale leaf** (Source; Ruth Amata KALRO)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease and lowering of quality due to spots
What is it? (TIMP description)	For leaf spot diseases, the integrated management package involves scouting for the disease, use of cultural control practices including crop rotation of Kales with non-brassica crops for at least 2 seasons, field hygiene and starting off with clean seedlings. Weeding to eliminate alternative hosts and avoidance of overhead irrigation to minimize spread through splash. New Kale varieties will be validated for their relative tolerance/resistance to leaf spot diseases in respective counties and appropriate varieties thereafter recommended. Use of recommended soft and safer (WHO Class III) fungicides with low PHI levels (e.g Iprodione based-Iprode 500 and azoxystrobin based-Maxidor)
Justification	Leaf spot diseases including those caused by *Alternaria* sp and *Mycosphaerella* sp. are a major challenge in Kale production in Kenya, occurring in most production areas. The disease causes significant yield loss both in terms of quantity and quality. Integrated Disease Management enables the alleviation of yield loss due to leaf spot diseases damage and increases yield and quality of produce using human and environmentally safe options.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Farmer involvement will be necessary for successful implementation of the IPM package. - Use of Indigenous Traditional Knowledge (ITK) can bepromoted and adopted faster. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted andaccepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-Kale growing counties of Kiambu, Kajiado, Nakuru Nyandarua
Counties where TIMPs will be upscaled	KCSAP target counties and other regions where Kale is grown
Challenges in dissemination	Farmers are not receptive to some of the cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land holdings and limited economic resources.
Suggestions for addressing the challenges	Training on alternative integrated disease management practices (use of clean seedlings, field sanitation, crop rotation) in managing the diseases.

Lessons learned in up scaling if any	• More than one approach is used in management of the Diseases - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Costs are to some extent minimized when using IDM since the cultural practices are mostly affordable
Estimated returns	-
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exist in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	Losses of about 30% are incurred due to leaf spot disease. Hence controlling the disease would reduce these losses
Application guidelines for users	Extension publications to be developed
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	1-Ready for upscaling 2-Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733- 00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)- Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama Lusike Wasilwa (KALRO Headquarters)
Partner organizations	- Extension service providers - FAO - NGOs - County governments

Research Gaps

Explore use of bio-control options for leaf spot diseases explore the use of ITKs in disease management

Evaluate new Kale varieties for disease tolerance

<table>
<tr><td>2.6.14 TIMP name</td><td>Integrated Management of Cauliflower Mosaic disease affecting Kales

Cauliflower Mosaic disease
(Source: infonet biovision)</td></tr>
<tr><td>Category (i.e. technology, innovation or management practice)</td><td>Management practice</td></tr>
<tr><td colspan="2">A: Description of the technology, innovation or management practice</td></tr>
<tr><td>Problem addressed</td><td>Yield loss due to disease</td></tr>
<tr><td>What is it? (TIMP description)</td><td>The management package for cauliflower mosaic disease includes scouting for the disease, use of certified seed, monitoring insect vectors (aphids) that transmit the virus, avoid working in fields when wet to prevent spread, uproot weeds that could serve as alternative hosts and use of bio- pesticides and soft/safe synthetic chemicals to control the vector (Biopesticides e.g Nimbecidine; Achook 0.15%; Neemroc 0.03%). Intercrop with chives, garlic, onions, radish, or parsley to repel virus vector (aphids); Varieties will be validated and up-scaled for their relative tolerance/resistance to this disease in respective counties. Use of soft/safe synthetic pesticides (WHO Class III) with very low PHI levels where vector levels are very high.</td></tr>
<tr><td>Justification</td><td>Cauliflower mosaic disease is a serious challenge in some varieties of Kale in Kenya. The disease is vectored by aphids, hence its control is pegged on the control of the vector. It causes significant yield loss and affects quality since it disables the ability of the plant to photosynthesize. Management using an integrated approach is recommended because it is environmental friendly and enables the control of the disease through control of vectors and cultural</td></tr>
</table>

	practises that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) to control vectors can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	- Promoted to farmers in counties mainly in Kiambu County
Counties where TIMPs will be upscaled	- KCSAP target counties and other Kale growing regions
Challenges in dissemination	- Farmers may not implement some of the practices e.g. Crop rotation due to small farms and limited economic resources. Need to avail biopesticides to agrovets closer to the farmers
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.

Lessons learned in up scaling, if any	- More than one approach is used in management of majordiseases - IDM is environment friendly and the chemicalcomponent should be used as the last resort - Participatory, farmer-centered approaches, whichencourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Costs for traps, biopesticides and soft synthetic pesticides for controlling the aphid which are the disease vectors
Estimated returns	- Losses caused by this disease are yet to be quantified
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	• Opportunities for unemployed youths exist in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications not yet developed
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling, 2-requires validation, 3-requires further research)
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; CABI-Duncan Chacha KALRO (FCRC Kitale)- Japheth Wanyama Lusike Wasilwa (KALRO Headquarters)
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps

Explore use of Bio-control options for cauliflower mosaic virus disease Explore the efficacy of ITKs in vector management of disease management Evaluate new Kale varieties for cauliflower mosaic virus disease tolerance

2.6.15 TIMP name	**Integrated Management of club root (*Plasmodiophora brassicae*) disease of Kales**  **Club root disease affecting Kale** (Source: ag.umass.edu)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to due to club root disease
What is it? (TIMP description)	Integrated management package for club root disease of Kales includes soil testing since the disease is favoured by acidic soils. Soil testing should be done. Raise soil Ph to more alkaline (PH 7.2). Use dolomite lime to control the disease. Control susceptible weeds in the brassica family e.g mustard and radish. Practice crop rotation with non-brassica crops for 3-4 years since the pathogen is able to last long in the soil, practise field hygiene, avoid surface run off as it spreads the pathogen to non-infected areas, uprooting affected plants and burning to reduce inoculum, disinfecting farm tools in jik solution (50ml:litre) to prevent spread are important. Solarize soils by digging / ploughing the land to expose the soil to high temperatures during hot weather. Kale varieties will be validated and up-scaled for their relative tolerance/resistance to club root disease in respective counties

Justification	Club root disease is a major challenge in Kale production in Kenya, occurring in all major production areas, but being more severe in areas with low pH (acidic soils). Failure to observe crop rotation especially in areas where land is a challenge leads to higher severity cases and spread of the disease. It causes significant yield loss because it causes swelling of the root system blocks the vascular system of the plant preventing water and nutrient uptake. Integrated Disease Management is an environmental friendly approach that enables the control of the disease through recommended cultural practises with create unfavourable conditions for the pathogen.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Need for farmer involvement helps generate locallyspecific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and
	accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments-Help in the dissemination of the technology

C: Current situation and future scaling up	
Counties where already promoted, if any	The management practices have been promoted mainly to farmers in Kiambu County
Counties where TIMPs will be up-scaled	KCSAP target Counties and other regions where Kale is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (soil testing, use of clean seedlings, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's on a small scale) in managing the disease.
Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the synthetic chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	- Cost of liming which is necessary to control the club root pathogen is a major cost. Basic costs range between KES 15000 to 20,000
Estimated returns	- Losses of 70-100% based on level of infestation. Higher losses are incurred where soils are acidic. Hence management of the disease would reduce such losses. Returns of 90000 to 200,000 are expected per acre per year depending on variety and duration of harvesting.
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths and women exists in uprooting the affected crops.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths exist in uprooting the affected crops.
: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications developed
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733- 00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471

Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)- Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau;Charity Gathambiri CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama Lusike Wasilwa (KALRO Headquarters)
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps

Evaluate new Kale varieties for club root disease tolerance

2.6.16 TIMP name	**Integrated Management of White mold (*Sclerotinia sclerotiorum*) disease**  **White mold disease** (Source:agric.wa.gov.au)
Category (i.e. technology,	Management practice
innovation or management practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease

What is it? (TIMP description)	For white mold disease, the integrated management package involves scouting for the disease, cultural practices including appropriate spacing to reduce overcrowding which creates a microclimate and enhances disease spread, cultural control involves crop rotation of Kale with non-brassica crops and other hosts including beans and peas for at least 4 years, field hygiene and use of disease free seedlings. Sanitize field tools. Soil solarisation by ploughing fields during hot weather and exposing to the sun. Enhance aeration in the field by using recommended spacing. Keep fields weed free since some are hosts to the disease. Use of Trichoderma based biocontrol agents' e.g Trichotech, Trianum-P, Rootgard, Eco-T at planting. Kale varieties and fungicides for the management of white mold will be evaluated and validated for their relative tolerance/resistance and control to white mold in respective counties.
Justification	White mold disease is a major challenge in Kale production especially once fields are infested due to survival features in the soil that are able to remain in soil for upto 4 years. The disease is severe because the pathogen produces abundant survival structures and currently has no effective fungicide control. This causes significant yield loss both in terms of quantity and quality. Losses of upto 100% where the disease has occurred in heavily infested fields. Integrated disease management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety considering that the Kale crop is consumed widely in large quantities among the Kenyan communities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations
	- Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training

Critical/essential factors for successful promotion	- Strong partnership linkages - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low- cost agricultural practices are easily promoted and accepted.
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted to farmers mainly in Central region of Kenya
Counties where TIMPs will be upscaled	KCSAP target Counties (Marsabit) and other regions where Kale is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean disease free seedlings, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.
Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer

	communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Practices that enhance field sanitation are key in managing the disease - Basic costs range between 10,000 to 15000 per year
Estimated returns	- Management of white mold disease would reduce losses by up to 80% where control measures are applied. Estimated returns range between 100,000 to 200,000 per year based on variety planted and duration of harvesting
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.s

VMG related opportunities	• Opportunities for unemployed youths as exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications and fact sheets to be developed
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Some of the management options are ready for upscaling 2-Some management options require validation e.g the tolerance of new varieties to pests and diseases needs to be established across counties
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; Charity Gathambiri CABI-Duncan Chacha KALRO (FCRC Kitale)- Japheth Wanyama KALRO (Headquarters)- Dr. Lusike wasilwa
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps
Assess the tolerance of Kale varieties to white mold
Further research is necessary to determine efficacy of biocontrol agents and fungicides in the management of white mold disease

2.6.17 TIMP name	**Integrated Management of White rust (*Albugo candida*) disease of Kales**  **White rust disease** (Source;saskmustard)

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease
What is it? (TIMP description)	For white rust disease, the integrated management package involves scouting for the disease, cultural practices including appropriate spacing to reduce overcrowding which creates a microclimate and enhances disease spread, cultural control involves crop rotation of Kale with non-brassica crops and other hosts including amaranthus for at least 2-3 seasons, field hygiene and use of clean disease free seedlings. Enhance aeration in the field by using recommended spacing and remove weeds which may serve as alternative hosts. Kale varieties will be validated and up-scaled for their relative tolerance/resistance to white rust in respective counties. Chemical control involving use of recommended registered safe soft fungicides (WHO Class 111) e.g azoxystrobin based (Maxidor) and Iprodione based (Iprode 500) will be assessed. New varieties will be assessed for tolerance to white rust disease and favourable varieties up- scaled.
Justification	White rust disease is a disease that affects Kale in major production areas. The disease produces white spores that cover mainly the leaves reducing the plants photosynthetic area and the quality. This causes significant yield loss both in terms of quantity and quality especially when severe. Losses above 30% have been experienced due to this disease. Integrated disease management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage. Adoption of an IPM approach would enhance food safety among the consumers by minimizing the use of pesticides and also contribute to environmental safety considering that the Kale crop is consumed widely in large quantities among the Kenyan communities. Adoption of an IPM approach would enhance food safety among the consumers since the Kale crop is consumed widely in large quantities among the Kenyan communities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's

Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted.
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the
	technology
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted to farmers mainly in Central region of Kenya
Counties where TIMPs will be upscaled	KCSAP target Counties and other regions where Kale is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean disease free seedlings, field sanitation, crop rotation, biological control and tolerant varieties in managing the disease.

Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices. - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM. - Market able to absorb increased supply of Kales.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Funds for undertaking cultural practices and fungicides are a pre-requisite for incorporating some of the control practices as part of the IPM strategy. Basic costs range between KES 10,000 to 15,000
Estimated returns	- Management of white rust would reduce losses by up to 80% where control measures are applied. Estimated returns range between 100,000 to 200,000 per cre per year based on variety grown and harvesting perion
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from

	decision making in development and dissemination activities • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths as exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications and fact sheets to be developed.
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	Ready for upscaling; 2-requires validation, 3-requires further research) 2-Some management options require validation e.g the tolerance of new varieties to pests and diseases needs to be established across counties
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; Charity Gathambiri CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr.Japheth Wanyama KALRO (Headquarters) Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps

Assess the tolerance of Kale varieties to white rust

Further research is necessary to determine effective fungicides for the management of white rust as this information is not available in the PCPB List of registered products.

2.6.18 TIMP name	**Integrated Management of black leg (*Phoma lingam*) disease of Kales**  **Black leg of crucifers** (Source:ag.umass.edu)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease
What is it? (TIMP description)	For black leg disease, the integrated management package involves scouting for plants that present symptom suggesting its presence. Cultural practices such as crop rotation with non-brassica crops e.g beans, and maize for at least 4 years, use of disease free seedlings, field hygiene by ensuring weed free fields and uprooting and burning of infected plant and prevention of surface run water that would spread the pathogen. Ensure proper drainage of soils. Assess the use of Trichoderma based products e.g Eco-T, Trichotech, Rootgard, and Trianum-P. Kale varieties and fungicides for the management of black leg will be evaluated and validated for their relative tolerance/resistance in respective counties.
Justification	Black leg disease of plants in the brassica family is a major challenge in Kale production especially once fields are infested due to survival features in the soil. The disease is severe because the pathogen produces abundant survival structures in the soil. Crop rotation periods are also longer due to the nature of the pathogen which produces survival structures in soil. These causes significant yield loss since it leads to wilting and death of plants. Integrated disease management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety considering that the Kale crop is consumed widely in large quantities among the Kenyan communities.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	Promoted to farmers mainly in Central region of Kenya
Counties where TIMPs will be upscaled	KCSAP target Counties and other regions where Kale is grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean disease free seedlings, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease.

Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.-
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kales
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Funds for biological control products is a pre-requisite for incorporating some of the control practices as part of the IPM strategy. Basic costs range at KES 10,000-20,000.
Estimated returns	- Management of black leg disease would reduce losses by up to 80% where control measures are applied. Estimated costs range between KES 100,000-200,000
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and

	dissemination activities • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.s
VMG related opportunities	• Opportunities for unemployed youths as exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications and fact sheets to be developed
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	1-Some of the management options are ready for upscaling 2-Some management options require validation e.g the tolerance of new varieties to pests and diseases needs to be established across counties
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; Charity Gathambiri CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama KALRO (Headquarters) Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - CGIAR's - NGOs - County governments

Research Gaps

Assess the tolerance of Kale varieties to black leg disease
Further research is necessary to determine effective fungicides for the management of black leg

2.6.19 TIMP name	**Integrated Management of bacterial soft rot (*Pectobacterium carotovorum subsp. carotovorum*.) disease of crucifers**   **Bacterial soft rot affecting Kale stem and leaves** (Source: Lusike Wasilwa) **Bacterial soft rot causing losses in crucifers production** (Source: Ruth Amata KALRO)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease
What is it? (TIMP description)	For bacterial soft rot disease of Kales, the management package involves scouting for disease occurence, cultural practises including crop rotation with non-brassica crops such as maize and beans, for a period of 3 years, rogueing out infected plants from the farm and burying, disinfecting farm tools in jik solution (50ml: litre), preventing surface run-off as it spreads the disease. Solarization of infested fields for at least a month by digging land and exposing soils during hot months. New Kale varieties will be validated and up-scaled for their relative tolerance/resistance to black rot in respective counties. Use of various copper based fungicides which are soft/safe synthetic pesticides will be validated for their usefulness in protective control of the disease.
Justification	Bacterial soft rot disease is a major challenge in Kale production in Kenya, occurring in major production areas. The pathogens also survives in the soil both at nursery and field level and is favoured by cool wet weather. Where it occurs, It causes significant yield loss because it leads to deterioration of plant tissues and eventually death. Integrated Disease Management is an environmental friendly approach that enables the control of the disease through cultural practises that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages between research institutions, extension and farmers - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Information can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	- Mainly promoted in Kiambu County and other counties growing crucifers
Counties where TIMPs will be upscaled	KCSAP target counties and other regions where Kales are grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on alternative integrated disease management practices (use of clean disease free seed, field sanitation, biological control, tolerant varieties and use of ITK's) in managing the disease.

Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the synthetic chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kales
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Costs are minimized when using IDM since the cultural practices are mostly affordable. Basic costs range between
	7,000 to 15,000.
Estimated returns	- The disease is able to cause losses of upto 100% if seedlings are infected at nursery level and if the fields are pathogen infested. Hence estimated returns range between 100,000 to 200,000 based on variety grown and duration harvested
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for unemployed youths exists in spraying the crop.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed youths as exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	- Extension publications and fact sheets developed
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	1-Ready for upscaling, 2-requires validation, 3-requires further research)
Contacts	
Contacts	The Centre Director, KALRO-Kabete;
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Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; Charity Gathambiri CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama KALRO (Headquarters)-Dr. Lusike Wasilwa
Partner organizations	- Extension service providers - FAO - NGOs - County governments

Research Gaps:
Explore the efficiency of using biocontrol agents and copper based fungicides on management of bacterial soft rot disease infection
Assess varieties for tolerance to soft rot disease

2.6.20 TIMP name	**Integrated Management of downy mildew (*Peronospora* spp.) diseases of Kales**   **Downy mildew affecting Kale** (Source;pnwhandbooks.org)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to disease and lowering of quality due to spots
What is it? (TIMP description)	For downy mildew disease, the integrated management package involves scouting for the disease, use of cultural control practices including crop rotation of Kales with non- brassica crops for at least 2 seasons, use certified seed, practise field hygiene and if starting off with seedlings ensure their cleanliness to avoid transferring the problem to the field. Weeding to eliminate alternative hosts and avoidance of overhead irrigation to minimize spread through splash. Rogue out infected plants from the farm and bury, disinfect farm tools in jik solution (50ml: litre). Ensure proper drainage. Uproot and destroy by burning or burying infected plants 2 feet deep. Enhance air circulation to reduce humidity in the field. New Kale varieties will be validated for their relative tolerance/resistance to leaf spot diseases in respective counties and appropriate varieties thereafter recommended. Use of recommended soft and safer (WHO Class III) fungicides with low PHI levels (e.g Iprodione based-Iprode 500)
Justification	Downy mildew disease is a major challenge in Kale production in Kenya, occurring in most production areas. The disease causes significant yield loss both in terms of quantity and quality. Failure to control the disease under favourable conditions may lead to losses above 30% and a compromised leaf quality. Integrated Disease Management enables the alleviation of yield loss due to downy mildew disease and hence increases yield and quality of produce using human and environmentally safe options rather than over-reliance on synthetic pesticides.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	- Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR’s
Approaches to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions
	- Farmer to farmer training
Critical/essential factors for successful promotion	- Strong partnership linkages - Farmer involvement will be necessary for successful implementation of the IPM package. - Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the dissemination - CGIAR’s - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	KCSAP target counties (Marsabit) and other regions where Kale is grown
Challenges in dissemination	Farmers are not receptive to some of the cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land holdings and limited economic resources.
Suggestions for addressing the challenges	Training on alternative integrated disease management practices (use of clean seedlings, field sanitation, crop rotation) in managing the diseases.

Lessons learned in up scaling, if any	- More than one approach is used in management of the diseases - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require acapacity building on crop monitoring and ecological principles
Social, environmental, policy and market conditions necessary for development and up scaling	- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of Kale
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Costs are to some extent minimized when using IDM since the cultural practices are mostly affordable - Basic costs range between KES 7,000-15000 per year
Estimated returns	- KES 100,000-200,000 per acre/year for varieties that are harvested for a long period (over a year)
Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women and youth have limited access to productive resources such as land and chemicals than men. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for unemployed youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to productive resources such as land, credit and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production

	techniques. • There is low adoption by VMGs due lack of awareness.s
VMG related opportunities	• Opportunities for unemployed youths as exists in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Extension publications developed
F: Status of TIMP readiness (1-Ready for upscaling, 2- requires validation, 3-requires further research)	1-Ready for upscaling 2-Requires validation
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO (FCRC Kabete)- Dr. Ruth Amata; KALRO (FCRC Muguga) Vincent Ochieng KALRO (PTC)-Anthony Nyaga KALRO (ICRI Sericulture)-Eliud Gatambia KALRO (HRI Kandara)-Eliezer Kamau; CABI-Duncan Chacha KALRO (FCRC Kitale)- Dr. Japheth Wanyama Lusike Wasilwa (KALRO Headquarters)
Partner organizations	- Extension service providers - FAO - NGOs - County governments

2.6.21 TIMP Name	**Kales Integrated Weed Management**
Crop management practices	Management practices
A: Description of the technology, innovation or management practice	
Problem addressed	Huge yield losses in Kales are attributed to competition from different weed species and poor weed management. Some key weed species occur in the region and are adapted to the kale cropping system due to their morphological and phonological characteristics. Competition occurs at four levels: 1) intraspecific competition between kales plants, 2) interspecific competition between Kales and weed species, 3) interspecific competition between weed species and 4) intra specific competition between same weed species. Presence of weeds in kale cropping system leads to an increased number of plants within a certain area. Given crop density is set at a level that optimizes yield for a cultivar in that environment, the presence of weeds will lead to decrease in

	average yield of the crop. Broadleaved weeds are the major problems because grasses are better managed by rotation or can successfully be eliminated with use of selective foliar applied herbicides. Weeds do not only compete for nutrients with the crops but also harbors insect pests and creates an environment conducive for disease occurrence. Limited knowledge in the weed flora makes it difficult to implement effective management approaches in a timely manner
What is it? (TIMP description)	Integrated Weed Management (IWM) is the management of weeds using two or more approaches including preventive, land preparation and tillage (Physical), use of biodegradable or synthetic mulch, cultural, biological control, and chemical control depending on the weeds infestation. Physical control is the removal of weeds manually or by mechanical means, such as hand weeding or mowing. In manual weeding farmers carry out manual weeding at 2 weeks after planting 2-3 weeks frequency. Biological control is where you graze animals. Chemical control is where appropriate herbicides are used to control weeds. Chemical weed management involves use of pre-emergence selective herbicides or post-emergence selective herbicides. Or pre- plant soil incorporated.
Justification	Majority of farmers in Kenya use manual approaches for weed management. Whereas this is effective, it is time consuming and labour intensive. Whereas manual weeding is effective it can also be ineffective because when weeding is done in wet conditions, all weeds are apparently replanted. Therefore regrowth becomes a big problem. Weeds are so diverse and therefore one approach will be effective on some species and not others. Therefore you need more than one approach to keep all weeds under control. Judicious use of pre- and post-emergence herbicides is a promising option for weed control in kales systems. Farmers who have used pre-emergence (within 24hrs after planting), and post emergence (at 2-4 leaves) have realized the higher yields than manual weeding. Post emergence is applied to control weeds which are existing and actively growing for effective control. Pre- emergence control weeds at germination stage or as they emerge from the soil. Use of herbicides is effective, time and labour saving. There are several registered herbicides (Pesticide Control Board Manual) on the market that can be used by Kales growers. Appropriate weed management leads to optimal yields and higher returns in kales production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension workers, Agrodealers

Approaches used in dissemination	Demonstrations and field days. Media (Online), manuals, pamphlets.
Critical/essential factors for successful promotion	Promote integrated weed management Address environmental and safety concerns related to the use of herbicides Accompany the promotion with demos and field days with farmers groups and stakeholders on the effectiveness of the various weed management options using FFSB approach. Train users on appropriate use of herbicide and safe use. Train people on biology of weeds and weed dynamics in cropping systems. Farmers need training on timing with regard to conservation of biodiversity. Preserve pollinators for increased productivity of weed control.
Partners/stakeholders for scaling up and their respective roles.	Agrochemical companies, Research partners (KALRO, CIAT), County extension staffs, NGOs
C: Current situation and future scaling up	
Counties where already promoted if any	Altitude areas of 1500-2000 meters above sea level e.g. Bomet, Nakuru, Nandi, Laikipia, Nyeri
Counties where TIMPs will be up scaled	Laikipia and Nyeri
Challenges in development and dissemination	High cost of herbicides Inadequate knowledge and information on which herbicides to use, when to use them and their persistence in the soil. Myths on appropriateness of using herbicides
Suggestion for addressing the challenges	Promotion of the product by conducting demos and field days and involvement of the stakeholder e.g. agro-chemical company. Develop and disseminate information to various stakeholders. Training on integrated approaches using available methods, including appropriate herbicides for kales. Their persistence in different soil environment that can affect follow up crops in rotation as a result of residues or carryover. Safe use of herbicides.
Lesson learned in up scaling if any	That integrated approaches of weed management are more effective than use of one control method and is environmentally friendly. A number of vegetables are produced under plastic mulch which may affect herbicide behavior reducing volatility and condensation phenomena and crop selectivity could be modified. Continue use of herbicide is an environmental, health and social hazard. Vegetable rotations are very fast and intensive in many places and

	herbicide toxicity can affect next crop if the cycle of previous crops is short enough. Consumers concerns
Social, environmental, policy and market conditions necessary for development and up-scaling	Train on understanding the working of an integrated weed management. Have an environmental and safety plan when using herbicides Address the environmental and social concerns related to use of agrochemicals. A functional agrodealer network to supply the products when required by the farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 4000
Estimated returns	KSH 1000 per acre
Gender issues and concerns in development and dissemination	• Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender issues and concerns in adoption and scaling up	• Opportunities for unemployed youths exists in spraying the crop.
Gender related opportunities	• VMGs have limited access to productive resources such as land and chemicals than men. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	• Opportunities for unemployed youths as exists in spraying the crop.
Gender issues and concerns in development and dissemination	Since weeding for Kales is mostly done by women and children, dissemination strategies should target women more but also take care of men and they become aware of the TIMP.
Gender issues and concerns in adoption and scaling up	Make all gender understand the benefits of IWM. Empower both men and women to make a judicious decision on IWM approach. Use of IWM technology can reduce drudgery due to manual weeding and save time for other activities to women

Gender related opportunities	Labour is reduced therefor an Opportunities exist for women and youth to get in other economic activities including the production, and marketing.
Vulnerable and marginalized groups (VMG) issues and concerns in development, dissemination, adoption and scaling up	VMG groups could be limited in accessing the knowledge, resources and exposed to many threats such as insecurity and land disputes.
VMG related opportunities	Training VMG on IWM practices and opportunities
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO , Kabete Dr Hottensiah Mwangi.
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, County Governments, KEPHIS

2.6.22 TIMP Name	**Kales Intercropping System**
Categories (i.e. technology innovation Or management practice)	Innovation
A: Description of the technology, innovation or management practice	

Problem addresses	Though mono cropping is recommended for higher yield production, farmers prefer inter-cropping kales with other crops eg tubers (cassava), bananas, and fruit trees. Poor intercropping results in low yields attributed to competition for light and nutrients and may lead to increased infestation of pests and diseases. Intercropping to control weeds requires specific spacing, the right choice of kales depending on growth habit of the intercrop. Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition.
What is it? (TIMP description)	Innovative kales Intercropping Systems are the application of growing more than one crop in a field at the same time, as a tool to enhance agricultural production and to obtain efficient land use. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping. Farmer's common intercropping system involves planting kales in between maize or between the fruit trees. Innovative intercropping systems involve arrangement with staggered 1-by-2 or 2-by-2 configuration between other crops, respectively. More complex intercropping systems with more than 2 crops have also been tested.
	

Justification	Cropping of several plant species together reduces negative effects of a monoculture and thus is commonly employed in ecological agricultural systems. Agricultural practices like intercropping are pro ecological; supporting bio- diversity and is compatible with the principles of balanced agriculture. Intercropping has important advantages in regard to efficient land use, increasing crop productivity and monetary returns thanks to effective use of various inputs compared to sole cropping. It can significantly increase total productivity as compared to sole cropping thanks to better utilization of water, nutrients and solar energy. Crops in these systems use available resources more efficiently thanks to different rooting and canopy properties which component plants species exploit resources complementary. Intercropping systems can cause more effective use of resources by providing symbiotic nitrogen from legumes, or making available inorganic phosphorus fixed in soil because of lowering of pH via nitrogen fixing legumes. Intercropping systems is a climate adaptation strategy in case of crop failure in mono cropping and is considered as one of the most dependable ways to maintain the sustainability of crop production. It is a risk mitigation strategy by farmers in light of prevailing climate change. Intercropping practices can ensure higher yield as well as productivity and profitability in crops per unit land. Intercropping systems with a Land Equivalent Ratio (LER) of 1:2 are considered better at using resources and profitable than mono-cropping systems Spatial regulations, physical and temporal barriers, microclimate modification, odor effects, and color and trapping effects between intercrops influence insect or disease situation or their natural enemies. Crop rotation and intercropping practices decrease weed population density and biomass yield Success of intercropping systems over sole cropping can be achieved by some agronomic manipulations. These manipulations can be planting time, plant density, available resources and intercropping patterns. Spatial arrangements, planting and harvest times of crops should be taken into account in intercropping systems.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	Demos and field days
Critical/essential factors for successful promotion	Conduct demos band the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staffs, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN, CIAT-PABRA)

C: Current situation and future scaling up	
Counties where already promoted if any	Altitude areas of 1,500-2,000 above sea level ie Bomet Nakuru, Laikipia, Nyeri, Bungoma, Kakamega, Siaya, Trans Nzoia, and Uasin Gishu
Counties where TIMPs will be up scaled	Nyeri and Laikipia
Challenges in development and dissemination	Inadequate training and limited extension staff
Suggestion for addressing the challenges	Facilitation of training of county extension staffs Contact demos and field days
Lesson learned in up scaling if any	Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits. There is need to adapt the technology when promotes in new environments/AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development ,dissemination, adoption and scaling up	• The technology may reduce women work burden when it comes to weeding. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	• Intercropping offers good opportunities for various gender categories e.g. men and women to grow diverse crops for economic gains.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Reduces labor demands across all gender categories. • VMGs have limited access to land for kales cultivation than men • Women have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	• Intercropping places emphasis on the importance of using available land space to grow a diversity crops thus increasing biodiversity, pest management for VMGs economic and health gains.
E: Case studies/profiles of success stories	
Success stories	MBILI-MBILI system work in Bungoma, Kakamega, Siaya, Trans Nzoia, and Uasin Gishu
Application guidelines for users	Extension and training material available

F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Require validation
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO Kabete, Dr Hottensiah Mwangi.
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

2.6.23 TIMP name	**Mulching**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds infestation, soil moisture and loss of organic matter, in ASAL.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials or synthetic materials. Mulches can effective control weeds from seeds that germinate near or at the soil surface. There are two types of mulches: biodegradable or natural mulches. Biodegradable include straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used ingrowing of climbing beans. Only black mulches should be used to control weeds. Benefits: Organic mulches retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose) and improves microclimate hence increasing biodiversity. Synthetic mulches will solarize soils, control weeds and weed seeds, retain soil moisture and controls diseases
Justification	Organic mulching has added benefits other than minimizing weeds infestation, it facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. It also improves soil; structure directly by preventing raindrop impact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers

Approaches to be used in dissemination	- Farmer field schools - On-farm demonstrations during farmer field schools - Training in workshops
Critical/essential factors for successful promotion	Organic: • Availability of plant or crop residues for organic mulches. • Size of the land. • Competing uses of crop residues. • Type of the cropsSynthetic • Cost of materials • Disposal of material after use.
Partners/stakeholders for scaling up and their roles	County government extension services; Provide link with farmers Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted	Not used in kales in Kenya. Used in Thailand.
Counties where TIMP will be promoted	Where Kales are a priority value chain. All the other 17 counties
Challenges in dissemination	• Lack of enough plant and crop residues due to competing uses in organic mulches. • Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.
Suggestions for addressing the challenges	• Crop diversification to increase availability of organic mulches. • Establish and follow a good integrated pest control management program for the particular kale varieties. • Adapting alternative mulching materials like high absorbance polymers in climbing varities.
Lessons learned	There is need to adapt to alternative mulching technologies in addition to use of organic materials like crop, plant residues.
Social, environmental, policy and market conditions necessary	• Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	Dependent on value chain but generally >100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Mulching is labour intensive hence it may increase the labour burden for the various gender categories. This may lead to the technology not to be adopted especially by women who are already overburdened. • The TIMP will reduce women's weeding time that can

	be used performing other productive activities.
Gender related opportunities	• The TIMP can offer employment opportunities for the youths. • The mulch is locally available on-farm.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Since the activity is labour intensive it may increase the labour burden for the various gender categories. This may lead to the technology not to be adopted. • The TIMP will reduce women's weeding time that can be used performing other productive activities.
VMG related opportunities	• The TIMP can offer employment opportunities for the youths. • The mulch is locally available on-farm.
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	User guidelines are dependent on value chain. 1.Plant beans in clean seed bed 2 Apply mulch between the rows of beans. Mulch management
	Pull or kill weeds that grow out of the mulch.
F: Status of TIMP readiness (1=Ready for upscaling: 2=Requires validation; 3=Requires further research	Ready to use.
G: Contacts	
Contacts	**Centre Director** KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi.
Partner organizations	County governments Public-Private-Partnerships

2.6.24 TIMP Name	**Chemical Weed Control**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Heavy weed infestation in kale cropping systems.

What is it? (TIMP description)	Chemical weed control refers to any technique that involves the application of herbicide to weeds or soil to control the growth or germination of the weed species. Herbicide weed control is a technology that requires knowledge on herbicides required for specific crops Recommended herbicides
Justification	Manual hand weeding is very labour intensive, scarce and expensive. Use of herbicides reduces drudgery and effects can be timely weed control.
Region promoted	Limited use of herbicide among small scale farmers
Counties where TIMP will be upscaled	Herbicide weed control can be upscaled in all the areas where beans are being grown.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of chemicals
Most effective approach	On-farm experimentation demonstrations. And larger plot effect
Critical/essential factors for successful promotion	Capacity building and training on safe use of chemicals for all users
Partners/stakeholders for scaling up and their respective roles	• Public and private partners –[MOALF&I) for extension, • Chemical companies for back stopping • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, • nutrition training etc.
C: Current situation and future scaling up	
Challenges in dissemination	Limited knowledge and information and low literacy levels among the farmers. Herbicide use and application requires knowledge and training on safe of herbicides. The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.
Recommendations for addressing the challenges	There is need to train the agricultural extension county officers as TOTs on safe use of herbicides. This help in reaching the farmers with the information. Herbicides like all chemicals have to be used with care to avoid environmental and social hazards. Liaise with the Agricultural extension and environmental officers on the ground for guidance on safe use of chemicals

Lessons learned	Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and safe use of chemicals is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Herbicide use is cheaper than manual weed control because it requires less labour.
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	• Women are the main sources of labour for this crop. Adoption of technology will reduce the labour burden on women
Gender related opportunities	• Opportunities exist for the youths to perform the task of spraying.
VMG issues and concerns in development and dissemination	• VMGs may have less access to credit required to purchase farm inputs • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Opportunities exist for the youths to perform the task of spraying
E: Case studies/profiles of success stories	
Success stories	.
Application guidelines for users	Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Requires validation; 3. Requires Research **)**	Requires validation and more research
G: Contacts	
Contacts	KALRO,
Lead organization and scientists	KALRO Dr Hottensiah Mwangi.
Partner organizations	ICRISAT Nairobi; MoALF in Counties , Chemical companies

2.6.25 TIMP Name	**Mechanical weeding**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weed control.

What is it? (TIMP description)	Plant clean certified seeds in weed free well prepared ground Planting to be done in rows to facilitate inter row weeding. Two weedings at 15 and 30 days after sowing (DAS) 2) **Row Weeders (Manual/ motorized)** These implements are used to weed between the rows. The intra row weeds are removed by hand pulling.
Justification	Weeds if not controlled will cause yield losses due to competition. They habour other pests (insects and diseases). Lower quality of the produce
Region promoted	All areas where beans grown
Counties where TIMP will be upscaled	All counties growing beans
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	• Public and private partners –[MOALF&I) for extension, • Jua Kali artisans • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Counties where already promoted	Nyandarua
Counties where TIMP will be promoted	Kiambu, UasinGishu, Tans Nzoia
Challenges in dissemination	Implements not readily available in the market.
Recommendations for addressing the challenges	Work with Jua Kali industries for fabrication of appropriate implements.
Lessons learned	Access and use of technologies will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the available technologies and management practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic cost of the weeder (implement is high -28,000 for ordinally kale farmers, they can purchase as a group.
Estimated returns	Not yet estimated

Gender issues and concerns in development ,dissemination, adoption and scaling up	• Women perform most of the crops weeding activities therefore the TIMP will reduce their work burden • Women and youth have limited access to credit to purchase the required implement. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for youths and women exists in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase the implement. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities for unemployed in operating the implement.
E: Case studies/profiles of success stories	
Success stories	Not yet accessible to kale farmers.
Application guidelines for users	Production manuals to include weed management TIMPs
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Validation 3. Requires further research**)**	1) Ready for up-scaling 2) Rower weeder is heavy so not friendly to women users. Research on gender sensitive weeders.
G: Contacts	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi.
Partner organizations	ICRISAT Nairobi; MoALF in Counties

2.6.26 TIMP Name	**Crop Rotation in Kales**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Weed and weed seed banks control in Kales cropping systems.
What is it? (TIMP description)	A good successive weed control strategy starting with a Farm Plan with a rotation schedule incorporated for optimal Kale production. All activities must be conducted at the right time. Divide into number of distinct areas. Keep plants of same type together. eg Kales-

	Beans or Peas-Pursley-carrot or onions. Kales is a heavy feeder and should follow legumes. Plant certified Kale seeds in rows or transplant into a clean weed free seed bed. Transplanting is the most critical time for obtaining good crop weed control but emphasize before making decision should be on environment, weeds present, time of year, crop rotation, irrigation methods and herbicide cost. Good rotation is achieved by combining cultural and herbicide weed management strategies. Two options 1. Form beds well before planting. Flush weeds grow. Knock them down with a post emergence herbicide or shallow weeding. 2. Form beds just before planting. Remove any emerged weeds. Or use pre-plant herbicides such as (glyphosate, paraquat and diquat) depending on weeds present, stage of weed growth and herbicide cost. You can start by applying appropriate herbicide targeting specific weeds on your land eg Glyphosate 0.3-1.0. Use hooded spray and direct to row middles Kales to control emerged grasses and broadleaved weeds. When weeds are small this reduces cost. The most effective management must be made before Kale is planted. Detailed weed information recoded or maps kept over time will help improve management decision with different crops in rotation
Justification	Choice and sequence of crop affect long term weed population dynamics and consequent weed management. Correct timely Crop Rotation minimizes weeds population in current Kale crop and reduces weed seed banks so there is less future infestations. Different crops grown in rotation break the cycle of weeds. The diversity of weed management strategies used for different crops also increases weed diversity and reduces prevalence of problem weeds that can build over time. Optimal timing for Cultural operations is most effective for weeds management because too early weeding does not achieve full benefits; since there is time for further weeds to germinate before canopy closes. Planting dates are important: Manage weeds four weeks after transplanting for optimal returns. Perennial weeds should be controlled during non- crop periods. Optimal production of kales depends on successful weed control. The most effective management must be made before crop is planted and this is taken care of when

	planning the rotation. To incorporate herbicide, crop varieties and size should be considered before selecting a herbicide.eg Use herbicides before seed emergence or five week old Kales transplant to avoid toxicity.
Region promoted	All areas where Kales are grown.
Counties where TIMP will be upscaled	All counties growing kales
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	On-farm experimentation and dissemination, field days,
	shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder sensitization.
Partners/stakeholders for scaling up and their respective roles	• Public and private partners –[MOALF&I) for extension, • Jua Kali artisans • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Counties where already promoted	Kiambu, Nyandarua
Counties where TIMP will be promoted	All Kale growing areas
Challenges in dissemination	Rotation schedules for Kales not readily available.
Recommendations for addressing the challenges	Work with farmers to validate known schedules from other researchers or countries in different kale growing regions.

Lessons learned	Use of appropriate crop rotation will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	Sensitization of communities on the crop rotation practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Basic cost of crop rotation for ordinally kale farmers: hand weeding expensive in short run but longer benefits in reduced seed banks.
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination	• Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Opportunities for women exist to perform other activities due to reduced weeding workload for them.
VMG issues and concerns in adoption and scaling up	• VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Increased production will improve food and nutrition security and economic empowerment of VMGs
VMG related opportunities	Increased production will improve food and nutrition security and economic empowerment of VMGs
E: Case studies/profiles of success stories	
Success stories	Kale farmers in Kangari-Murang’a County.
Application guidelines for users	Production manuals to include crop rotation weed management TIMP
F: **Status of TIMP Readiness (**1. Ready for up-scaling; 2. Validation 3. Requires further research**)**	2. Ready for validation
G: Contacts	
Contacts	KALRO
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi, Charity Muchira and Dr J.M. Maina.
Partner organizations	ICRISAT Nairobi; MoALF in Counties

2.6.27 TIMP Name	Safe Use of Herbicides
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Excessive pesticides application to crops, use of pesticides for spraying crops without wearing the right protective clothing, storage of pesticides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, use of pesticides without following the guidelines provided on the labels. Inadequate enforcement of global policies and regulation on use of pesticide
What is it? (TIMP description)	Capacity building of farmers and crop protection teams on safe handling and use of herbicides right from transportation from the agro-dealers to storage in their houses, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large. The management will include proper methodologies for proper herbicide disposal to minimize pollution of the environment, health and social hazards.
Justification	Although cases of improper use of herbicides are very common in most of the areas where maize is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the herbicides in theprocess of spraying, use of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risksas well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users to be made aware of the best practices that should be used when handling pesticides. There has been reports of increase of chronic diseases in human beings
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Kale growers.
Approaches used in dissemination	Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinics, Pesticides spray Demonstrations
Critical/essential factors for successful promotion	Collaboration between all partners, willingness of farmers to adhere to proper guidelines Adequate facilitation: funds, logistics (transport)

Partners/stakeholders for scaling up and their roles	Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers farmer groups/CBOs to participate in the implementation of the various technologies for kale production, KALRO and Universities to develop the technologies and conduct ToTs. CABI, AAK, PCPB, KEPHIS
C: Current situation and future scaling up	
Counties where technology is already being promoted if any	Nakuru, Trans Nzoia, Kakamega, Bungoma, Machakos, Makueni, Nyeri, Laikipia
Counties where TIMPS will be up scaled	Nyandarwa, Kiambu, Murang'a, Nyeri and Laikipia
Challenges in dissemination	• Change of mindset in favour of current practices maybe difficult to achieve, • Illiteracy and inadequate capacity to use pesticides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of pesticides • Use of banned pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose pesticides properly
Suggestions for addressing the challenges	• Capacity building and sensitization forums for both farmers and agro dealers using participatory approach • Formation of youth spray teams • Establishment of aggregation centres for pesticide containers • Establishment of training of Extension staff and lead farmers as TOT • Increase surveillance along the border points and enforce the laws_
Lessons learned in upscaling if any	Upscaling of this technology needs young men and youth due to its hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collection and incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of pesticides in some areas.
Social, environmental, policy and market conditions necessary	Organized collective marketing channels critical for benefits to be derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES per acre
Estimated returns	KES 0 per acre

Gender issues and concerns in development, dissemination, adoption and scaling up	• Technology is not safe for use by expectant women and the physically challenged individuals because of it hazardous/dangerous nature • Pesticides and protective gear are expensive and most women may not afford them • Lack of knowledge by men and women on the dangers of chemicals especially on storage and disposal • Low levels of illiteracy and inability to read and interpret the content of the pesticides labels especially on re-entry period after spraying and PHI. This cause pesticides poisoning to men and women who spray and harvest
Gender related opportunities	• Formation of spray teams by men • Formation of surveillance/scouting groups by women
VMG issues and concerns in development, dissemination, adoption and scaling up	• These are dangerous products that may not be handled by vulnerable groups • Pesticides are expensive for most youths and physically challenged groups that may not utilize them
VMG related opportunities	• Safe use of pesticides practice can easily be undertaken by the youth as an enterprise by forming Spray teams in the wards in each county • Youths to offer spray calibration services to farmers as an enterprise • Youths groups to form surveillance/scouting teams to help farmers in pest and disease diagnostic services • Youths to help in the collection of pesticide containers and assist in the incineration processes by AAK • Youth to own and operate agro chemicals that stock right pesticides and offer pest and disease advisory services to farmers at the agrovet shops
E: Case studies/profiles of success stories	
Success stories	• The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people being exposed to pesticides • There are reported cases of farmers who regularly scout their
	crop that have reported to using less pesticides on their farm • Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction of these containers on farms. • Safe use of Pesticide campaigns by AAK, PCPB, KALRO and MOAL&F.

Application guidelines for users	Sensitization of farmers on the harmful effects of the pesticides on human beings and environment. Capacity build farmers and youth on spraying techniques using developed curriculum by AAK and PCPB. Assist youth to form spraying teams and equip them with PPEs. Train Extension staff as Plant doctors using the CABI modules, manuals and establish Plant Clinics in the target counties. Develop and equip the Plant Doctors and youth spraying teams with pest decision guidelines, manuals, brochures developed by KALRO and CABI as reference material
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling;
F: Contacts	
Contacts	Centre Director KALRO Kabete
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr Jedidah M. Maina and Charity W. Muchira.
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

Ref: A guide to Effective Weed Control in Vegetable industry Development Program. Horticulture Austraria. HAL

Weed Control in Cole or Brassica leafy vegetables (Broccoli, Cabbage, Caulifoer, Collard, Mutard, Turnip, and Kale. Peter J.Dittmar, Nathan S.Boyd, and Ramdas

2.7 POST HARVEST HANDLING OF KALE

2.7.1 TIMP name	**Harvesting procedure**
Category (i.e. technology, innovation or management practice)	Management Practices
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of information and expertise in appropriate harvesting practices to maintain kale quality
What is it? (TIMP description)	This is management practice which involve use proper maturity indices, appropriate harvesting method and containers. Harvesting of kales is done six weeks after planting. They can be harvested by uprooting the whole plants or plucking some leaves.

Justification	Kale destined for markets should be harvested using appropriate practices. This ensures good quality of produce with long shelf-life. Improper harvest timing of kales results in poor quality produce. There is need for capacity building farmers on this aspect.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension service providers
Approaches used in dissemination	Farmer trainings, Field Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Farmer Participatory Demonstrations/ Farmer field schools
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	All counties
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	-Maturity indices are based on visual assessment
Suggestions for addressing the challenges	Awareness creation on the management practice and capacity building on maturity indices and harvesting techniques
Lessons learned in up scaling if any	
Social, environmental, policy and market conditions necessary for up scaling	-Organized marketing channels critical for benefits to be derived from technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Opportunity exist for youths and youths in harvesting the kales.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land, credit, and quality seed. • VMGs have limited access to training and extension services.

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunity exist for youths and women in harvesting kales
E: Case studies/profile of Success stories	
Success stories from previous similar projects	Youth groups in Kiambu, farmers in peri-urban Nairobi County
Application guidelines for users	Use practical guidelines on how to harvest Provide fact sheets on maturity indices and harvesting
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Validation
G: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	MOA, Traders, Processors

2.7.2 TIMP name	**Postharvest handling practices**
Category (i.e.technology,innovation or management practice)	Management practices
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of information and expertise in kales postharvest handling practices of after which results in high postharvest losses
What is it? (TIMP description)	**Appropriate postharvest handling practices** -Holding containers -Sorting and grading - Pre-cooling at farm level -Packaging (plastic crates)
Justification	Kales are perishable produce that require careful handling from harvesting upto market to ensure maintenance of good quality. Farmersand other actors along the value chain do not follow recommended practices. This leads to high postharvest losses. There is need to sensitize farmers and other chain actors on importance of proper postharvest

	handling practices and capacity build them on best practices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension service providers
Approaches used in dissemination	Farmer trainings, Field Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Kiambu and Busia
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited extension officers with knowledge on postharvest handling procedures
Suggestions for addressing the challenges	-Training of TOTs
Lessons learned in up scaling if any	Farmer participatory approach works
Social, environmental, policy and market conditions necessary for up scaling	-Organized marketing channels is critical for benefits to be derived from technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women have limited access to education, training and extension services than men.
Gender related opportunities	• Opportunity exist for women sorting and grading while the youths males can package in crates.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.

VMG related opportunities	• Opportunity exist for women sorting and grading while the youths' males can package in crates.
E: Case studies/profile of Success stories	
Success stories from previous similar projects	None
Application guidelines for users	Kales cultivation manual, brochures and factsheet with detailed guidelines on kale postharvest handling practices documented,
F: Status of TIMP readiness 1) Ready for up scaling 2) Requires validation 3. Requires further research	Ready to upscaling
F: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	MOA, Traders

2.7.3 TIMP name	**Charcoal cooler**
Category (i.e. technology, innovation management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of cheaper cooling technology. Cooling of kales produce at farm level to reduce postharvest losses
What is it? (TIMP description)  Charcoal cooler	Charcoal cooler is an evaporative cooling unit that offers short term storage of kales. The cooling unit is constructed using cheaper and locally available materials
Justification	Kales are highly perishable therefore they should be at low temperature to enhance their shelf life. High temperature increases respiration rate and enhances postharvest rots. Cooling kales at farm level improves the shelf life and maintains quality. Charcoal cooling unit offers cost effective
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers, traders, extension service providers
Approaches used in dissemination	Farmer trainings, Field Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Kirinyaga,Tharaka-Nithi, Meru for other horticultural produce
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited materials to construct the charcoal cooler
Suggestions for addressing the challenges	-Training of TOTs
Lessons learned in upscaling if any	Farmer participatory approach works
Social, environmental, policy and market conditions necessary for upscaling	-Organized marketing channels is critical for benefits to be derived from technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Opportunity exist for youth males in constructing the cooling unit using the readily available materials.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities.

	• There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunity exist for youth males in constructing the cooling unit using the readily available materials.
E: Case studies/profile of Success stories	
Success stories from previous similar projects	-Youth groups in Kiambu, farmers in peri-urban Nairobi County
Application guidelines for users	Proper training on construction guidelines is very essential
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for up scaling
F: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO: Charity Gathambiri, Francis Wayua, Antony Nyaga Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	University of Nairobi, MOA, Traders, Processors

2.7.4 TIMP name	**Zero Energy cooling Unit**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of cost effective cheaper cooling technology unit for kales produce at farm level to reduce postharvest losses
What is it? (TIMP description)  Zero Energy Cooling Unit	Zero energy cooler is an evaporative cold storage that offers short time storage for fresh produce. It reduces the temperature and increases relative humidity during storage essential in maintaining the freshness of kales and prolong their shelf life.
Justification	Kales are highly perishable therefore they should be stored at low temperature and high relative humidity to enhance their shelf life. High temperature increases respiration rate and enhances postharvest rots. Cooling kale at farm level improves the shelf life and maintains quality. Zero energy unit offers cost effective cold storage unit. The unit is developed using locally available materials that are environmental friendly.

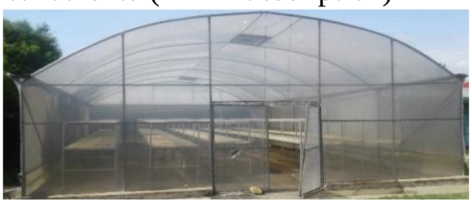
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension service providers
Approaches used in dissemination	None
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Ministry of Agriculture-Extension Service, individual Farmers, farmer groups/CBOs, Youth Groups Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and increase production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	The technology has been promoted for other horticultural produce such tomatoes , mango in Tharaka Nithi, Embu and Machakos
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	`
Suggestions for addressing the challenges	None
Lessons learned in upscaling if any	None
Social, environmental, policy and market conditions necessary for upscaling	-Organized marketing channels is critical for benefits to be derived from technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Opportunity exist for youth males in constructing the zero energy cooling unit using the readily available materials.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit. • VMGs have limited access to training and extension services.

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunity exist for youth males in constructing the zero energy cooling unit using the readily available materials.
E: Case studies/profile of Success stories	
Success stories from previous similar projects	None
Application guidelines for users	The cooler should be well-constructed to maintain low temperatures and high humidity inside the unit
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for up scaling
F: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO Charity Gathambiri, Francis Wayua, Antony Nyaga Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	University of Nairobi, MOA, Traders, Processors

2.7.5 TIMP name	**Modified Atmosphere Packaging (MAP)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses that occurs due to high perishability of kale.
What is it? (TIMP description)	MAP is use of barrier packaging material such as polybags that controls exchange of gas in and out of packaging containers. The packaging material allows modification of gas inside creating a suitable atmosphere to improve the shelf life of produce. The modification lowers amount of oxygen and increases inert gas these are carbon dioxide and nitrogen. Low levels of oxygen reduces rate of respiration and infestation by pathogens thus improving the shelf life of kale.

Justification	Kale are highly perishable, proper packaging enhances their shelf life. High respiration rate during packaging increases postharvest losses. Modified Atmosphere Packaging reduces respiration rate due to modification of gas inside the package.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension service providers
Approaches used in dissemination	Farmer trainings, Field Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful	Good collaboration between all partners
promotion	Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited information on technology
Suggestions for addressing the challenges	-Training of TOTs
Lessons learned in upscaling if any	Farmer participatory approach works
Social, environmental, policy and market conditions necessary for upscaling	-Organized marketing channels is critical for benefits to be derived from technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	• Opportunity exist for youth males in manufacturing and selling MAP.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge. • VMGs have limited access to productive resources such as land and credit. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunity exist for youth males in manufacturing and selling MAP.
E: Case studies/profile of Success stories	
Success stories from previous similar projects	-None
Application guidelines for users	Training
F: Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Validation
F: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika director.hri@kalro.org
Lead organization and scientists	KALRO: Charity Gathambiri, Francis Wayua, Antony Nyaga
Partner organizations	MOA, Traders, Processors

2.7.6 TIMP Name	**Solar drier to dehydrate kales**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	-High Postharvest losses in kales -Low returns during glut harvest -Lack and /or limited information, expertise and skills in kales dehydration
What is it? (TIMP description)  Solar drier	Solar drying is use of solar energy to dehydrate kales. There are two types of solar driers namely natural convection solar and forced air convention solar drier. Natural convection drier is not suitable for small scale farmers due to low buoyance of air movement while forced convection improves rate of air movement. In this case tunnel drier which is forced convection will be used

	to dehydrate kales.
Justification	Kale is highly perishable resulting to high postharvest losses and short shelf life. Processing of kales into dried products enhances shelf life thus ensuring availability during off season. Agro- processing add value to the kales, this increases their economic value thus giving better returns to farmer or various value chain actors. Dehydrating kales into products also diversify market and usage of kales.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders/processors and Extension service providers
Approaches used in dissemination	Value chain actors trainings, Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull
	production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	The technology has been promoted for other horticultural crops in Kakamega, Embu, and Tharaka Nithi Counties
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited processing infrastructure available to interested beneficiaries Short shelf life of processed products especially preserves Lack of quality standards of processed products
Suggestions for addressing the challenges	-Access to credit -Availability of small scale processing equipment -Develop technology on how to extend kale preserves

Lessons learned in upscaling if any	Demonstrations approach works Effective extension services is essential for adoption of the technologies
Social, environmental, policy and market conditions necessary for upscaling	Organized producers groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women and youth have limited access to education, training and extension services than men. • Women and youths may have limited access to credit to purchase the solar drier to dehydrate kales.
Gender related opportunities	• Employment Opportunities exist for youth and women to perform the task of kale dehydration. • Women and youth stand to benefit in production, use and sale of dehydrated kales
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to 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	• Employment Opportunities exist for youth and women to perform the task of kale dehydration • Opportunity to produce, trade in, and consume dehydrated kales
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Embu in other horticultural produce especially in mango
Application guidelines for users	Brochures and factsheets with detailed guidelines on kale sauce documented, Radio and TV broadcasts, shows, trade fairs
Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org

Lead organization and scientists	KALRO: Charity Gathambiri, Francis Wayua, Antony Nyaga Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	MOA, Traders, Processors

2.7.7 TIMP Name	**Dehytray Technology**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	-High Postharvest losses in kales -Low returns during glut harvest -Lack and /or limited information, expertise and skills in kales dehydration
What is it? (TIMP description)  Dehytray Solar drier	Solar drying is use of solar energy to dehydrate kales. Dehytray technology is friendly to all gender especially women.
Justification	Kale is highly perishable resulting to high postharvest losses and short shelf life. Processing of kales into dried products enhances shelf life thus ensuring availability during off season. Agro- processing add value to the kales, this increases their economic value thus giving better returns to farmer or various value chain actors. Dehydrating kales into products also diversify market and usage of kales.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders/processors and Extension service providers
Approaches used in dissemination	Value chain actors trainings, Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)

Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	The technology has been promoted for other horticultural crops in Kakamega, Embu, and Tharaka Nithi Counties
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited processing infrastructure available to interested beneficiaries Short shelf life of processed products especially preserves Lack of quality standards of processed products
Suggestions for addressing the challenges	-Access to credit -Availability of small scale processing equipment -Develop technology on how to extend kale preserves
Lessons learned in upscaling if any	Demonstrations approach works Effective extension services is essential for adoption of the technologies
Social, environmental, policy and market conditions necessary for upscaling	Organized producers groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to information, technology and knowledge. • Women and youth have limited access to education, training and extension services than men. • Women and youths may have limited access to credit to purchase the tray driers to dehydrate kales.
Gender related opportunities	• Employment Opportunities exist for youths and women and women in performing the operation
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs have limited access to 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	• Employment Opportunities exist for youth and women to perform the task of kale dehydration

	• Opportunity to produce, trade in, and consume dehydrated kales.
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Embu in other horticultural produce especially in mango
Application guidelines for users	Brochures and factsheets with detailed guidelines on kale sauce documented, Radio and TV broadcasts, shows, trade fairs
Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Ready for up-scaling
G: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO: Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	MOA, Traders, Processors

2.8 VALUE ADDITION IN KALE

2.8.1 TIMP Name	**Kale Flour**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	-High Postharvest losses in kales -Low returns during glut harvest -Lack and /or limited information, expertise and skills in kales flour making
What is it? (TIMP description)	Solar drying is use of solar energy to dehydrate kales. There are two types of solar driers namely natural convection solar and forced air convention solar drier. Natural convection drier is not suitable for small scale farmers due to low buoyance of air movement while forced convection improves rate of air movement. In this case tunnel drier which is forced convection will be used to dehydrate kales.
Justification	Kale is highly perishable resulting to high postharvest losses and short shelf life. Processing of kales into dried products enhances shelf life thus ensuring availabilityduring off season. Kale flour processing add value to the kales, this increases their economic value thus giving better

	returns to farmer or various value chain actors. Preparation of kales into products diversify market andusage of kales
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders/processors and Extension service providers
Approaches used in dissemination	Value chain actors trainings, Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	The technology has been promoted for indigenous crops in Kakamega, Kiambu and Nyeri Tharaka Nithi Counties
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited processing infrastructure available to interested beneficiaries Lack of quality standards of processed products
Suggestions for addressing the challenges	-Access to credit -Availability of small scale processing equipment
Lessons learned in upscaling if any	Demonstrations approach works Effective extension services is essential for adoption of the technologies
Social, environmental, policy and market conditions necessary for upscaling	Organized producers groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	WoWomen may have less access to information, technology and knowledge. Women may have limited access to education, training and extension services than men
Gender related opportunities	Employment opportunities exist for women in making the kale flour.

VMG issues and concerns in development, dissemination, adoption and scaling up	VMVMGs have less access to agricultural information, technology and knowledge. VMGs have limited access to training and extension services. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness
VMG related opportunities	Employment opportunities exist for women in making the kale flour.
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Embu in other horticultural produce especially in mango Nyeri, Kiambu and Kakamega
Application guidelines for users	Brochures and factsheets shows and trade fairs
Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Validation
G: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO: Charity Gathambiri, Francis Wayua, Antony Nyaga Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	MOA, Traders, Processors

2.8.2 TIMP Name	**Kale Juice**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Kales are highly nutritious and therefore processing the produce into juice improves their consumption which ensures food nutrition security. Also kales are perishable high leading to postharvest losses in kale. Lack and /or limited information, expertise and skills in kales juice making

What is it? (TIMP description)	Solar drying is use of solar energy to dehydrate kales. There are two types of solar driers namely natural convection solar and forced air convention solar drier. Natural convection drier is not suitable for small scale farmers due to low buoyance of air movement while forced convection improves rate of air movement. In this case tunnel drier which is forced convection will be used to dehydrate kales.
Justification	Kales are good source of Vitamin C and minerals thus contributing to food and nutrition security. Processing kales into juice improves on its consumption and diversifies its products
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders/processors and Extension service providers
Approaches used in dissemination	Value chain actors trainings, Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited processing infrastructure available to interested beneficiaries Lack of quality standards of processed products
Suggestions for addressing the challenges	-Access to credit -Availability of small scale processing equipment
Lessons learned in upscaling if any	Demonstrations approach works Effective extension services is essential for adoption of the technologies
Social, environmental, policy and market conditions necessary for upscaling	Organized producers groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done

Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	Women may have less access to information, technology and knowledge on the technology. Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	Employment opportunities exist for women in making kale juice product for both home consumption for sale.
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs may have less access to agricultural information, technology and knowledge on the technology. VMGs have limited access to training and extension services on the technology. 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	Employment opportunities exist for some VMGs such as women in making kale juice product for both home consumption and for sale.
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been done in Embu in other horticultural produce especially in mango Nyeri, Kiambu and Kakamega
Application guidelines for users	Brochures and factsheets shows and trade fairs
Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3. Requires further research	Further research
G: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO: Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandera, Japheth Wanyama
Partner organizations	MOA, Traders, Processors

2.8.3 TIMP Name	**Kale chopping**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem addressed	Chopping of kales add value to the produce. In urban areas and also youth are encouraged to consume kales since chopping reduces time for preparation during cooking. Lack and /or limited information, expertise and skills in kales juice making
What is it? (TIMP description) 	Kale chopping ensures quick preparation of kales. The technology is suitable for institutions such as hospitals, schools and colleges.
Justification	Kales are good source of Vitamin C and minerals thus contributing to food and nutrition security. Kales chopping improves on its consumption and diversifies its products.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders/processors and Extension service providers
Approaches used in dissemination	Value chain actors trainings, Demonstrations, Farmer Field Schools, shows, trade fairs
Critical/essential factors for successful promotion	Good collaboration between all partners Adequate facilitation: Funds, Logistics (Transport)
Partners/stakeholders for scaling up and their roles	• Agricultural Extension: Farmer sensitization, On farm and on station demonstrations • Market players to create demand and pull production • Farmer leaders: Group organization • NGOs dealing with kales to disseminate the practices
C: Current situation and future scaling up	
Counties where already promoted if any	Nairobi
Counties where TIMP will be upscaled	Marsabit
Challenges in dissemination	Limited processing infrastructure available to interested beneficiaries Lack of quality standards of processed products
Suggestions for addressing the challenges	-Access to credit -Availability of small scale processing equipment
Lessons learned in upscaling if any	Demonstrations approach works Effective extension services is essential for adoption of the technologies

Social, environmental, policy and market conditions necessary for upscaling	Organized producers groups to ensure consistence availability of raw materials Organized marketing channels
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have less access to information, technology and knowledge on the technology. • Women may have limited access to education, training and extension services on the technology.
Gender related opportunities	Employment opportunities exist for women in chopping kales for both home consumption for sale.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMVMGs may have less access to agricultural information, technology and knowledge on the technology. • VMGs have limited access to training and extension services on the technology. • 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	Employment opportunities exist for some VMGs such as women in chopping kales for both home consumption and for sale.
E: Case studies/profile of success stories	
Success stories from previous similar projects	This has been used in urban areas especially Nairobi
Application guidelines for users	Brochures and factsheets shows and trade fairs
Status of TIMP readiness 1) Ready for upscaling 2) Requires validation 3.Requires further research	Validation
G: Contacts	
Contacts	Horticulture Research Institute P.O Box 220-0100 Thika Director.hri@kalro.org
Lead organization and scientists	KALRO: Gathambiri Charity, Antony Nyaga, Eliud Gatambia, Kamau Eliezer, Ruth Amata, Fredrick Wandra, Japheth Wanyama
Partner organizations	MOA, Traders, Processors

2.9 MECHANIZATION OF KALES PRODUCTION ACTIVITIES

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

their roles	NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations • Increase Labour productivity • Increase land productivity • Decrease cost of production • Enhance quality of produce • Reduce drudgery • Strengthens entrepreneurship • Enhances Industrialization through cottage industry sprouting • Triggers Manufacturing and agro-processing
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the power tiller. • Women and youth have limited access to education, training and extension services than men.

	• Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • 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	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • 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	• 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	Nasirembe.wanyonyi@kalro.org
Lead organization and scientists	KALRO, Egerton University Nasirembe W,

Partner organizations	Agricultural machines dealers

2.9.2 TIMP Name	**Wheeled Tractor 50Hp**
Category (i.e. technology, innovation or management practice y:	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Kales commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)	A small sized, a 4 wheeled tractor is a low powered agricultural implement of 40-55hp that can be fitted with a rotary tiller, disk harrow, moldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete 4 hectares per day by one operator but can have two operators to run another 8 hours of 4 hectares coming to 8 per day. This will vary depending on the climatic conditions, soil types, soil moisture content and operator experience. Fuel consumption is about 15 litres per ha. Though these results may vary with the technical ability of the operator.
Justification	It has multiple uses and other advantages. A Power Tiller can be used in seedbed preparation soil, sowing seed, planting seed, spraying fertilizer, herbicide and even irrigation. In addition, can also be used for threshing through a power take off device and transporting produce. Farm sizes less than one hectare may limit maneuverability of conventional tractors and manual labour is costly and slow.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales farmers and researchers
Approaches used in dissemination	Field demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost

Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery dealers NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the tractors • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations • Increase Labour productivity • Increase land productivity • Decrease cost of production • Enhance quality of produce • Reduce drudgery • Strengthens entrepreneurship • Enhances Industrialization through cottage industry sprouting
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1,780,000,00
Estimated returns	KES 450,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the wheeled tactor.

	• Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • 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	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • 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	• 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	

Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Agricultural machinery dealers

2.9.3 TIMP Name	**Mouldboard plough**
Category (i.e. technology, innovation or management practice	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Kales commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)	Mouldboard plough is an agricultural implement and is generally considered to be the important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. A mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice, c) inverting the furrow slice and d) pulverizing the furrow slice Ploughing accounts for more traction energy than any other field operation.
Justification	High Efficiency. When well-adjusted, the plough automatically seeks the desired depth. It is Versatility. The various models have different features that enable high efficiency in preparation of the land. Weed Control. Pest Control. Improved Soil Health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost

Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 550,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the mouldboard Plough. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden.

	• 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	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • 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	• 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	Nasirembe W, KALRO, Egerton University
Partner organizations	Local Fabricators

2.9.4 TIMP Name	**Disk Harrow**

Category (i.e. technology, innovation or management practice practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedbed preparation, in a commercialized Kales commodity • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour
What is it? (TIMP description)	It is an implement consisting of a heavy frame set with teeth or tines which is dragged over ploughed land to break up clods, remove weeds, and cover seed and is a cultivating tool set with used primarily for breaking up and smoothing the soil in preparation of a seedbed for small sized grain planting.
Justification	Creating of a crumbly layer for planting is tedious. It is not possible to manually protect the soil surface from rapid drying. Improving both the air and water penetrability into soil manually can be too expensive if manually undertaken. Manual operation will reduce microbiological processes in the soil. Manual land harrowing Improving of nutrient availability to plants.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Lack of machines • Lack of facilitation for demonstration • High initial cost for small-scale machines

Suggestions for addressing the challenges	• Acquisition of the machines • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Men perform the land preparation activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the disk harrow implement. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • 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	• Introduction of the labor intensive implement will reduce men’s labor burden of VMGs such as the elderly and those abled differently. • 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	• 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W.W.
Partner organizations	Local Fabricators

2.9.5 TIMP Name	**Multi-function seedbed ridging machine**
Category (i.e. technology, innovation or management practice	Technology 
A: Description of the technology, innovation or management practice	

Problem to be addressed	• Poor drainage during plant growth • Insufficient root growth • Poor root aeration • Poor infiltration
What is it? (TIMP description)	Bed shapers with shaping disks form new beds from flat ground. One-pass "quick" bedding is conventional in easy-working soils. First prepare soil to seedbed condition with conventional tillage equipment. One-pass bedding can be done equally well in many soil types provided soil is tilled equally well. Needed tractor power primarily depends on bed height. A rugged, versatile, user-friendly equipment, we provide knowhow to allow growers in all regions to take advantage of raised beds to grow better crops. Bed Shapers intelligently adapt to the local environment, local soil types and local tillage practices
Justification	Machine seedbed ridging is uniform in tilth and height. It saves time in ridge formation of seedbeds, cheaper and enhances labour productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings • Encourage entrepreneurs to invest in equipment hire service

Lessons learned in up scaling if any	• Low scale of seedling production does not encourage use of a machine • There is lack of awareness about the machine • Has capacity to produce a large number of seedling within a short time
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Seed tray planter 325,000 KES per unit
Estimated returns	KES 150,000/Month
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crop production activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the seedbed ridger. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs have limited access to credit to purchase seedbed ridger. • 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	• Employment opportunities exist for youth males and males in operating the implement.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals

F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W,
Partner organizations	Local Fabricators

2.9.6 TIMP Name	**Kales direct drill**
Category (i.e. technology, innovation or management practice	 Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seed placement • Difficult to prepare a uniform fine tilth seedbed manually • Delayed operation lead to late planting • High cost of manual labour
What is it? (TIMP description)	A Kales planter is a device used in agriculture that opens furrows meters, sow seeds for Kales by positioning them in the soil and burying them to a specific depth without forming a ridge along the seed row. The Kales planter sow seeds at the proper seeding rate and depth, ensuring that the seeds are covered by soil.

Justification	• Manual planting increase the amount of seed used and may require thinning • Fertilizer use is not evenly distributed when manually applied • Kales seed is small making planting depth critical and difficult to attain when manually done and seed shallowly planted will germinate with poor yields • Raw planting increases yields, easy to manage weeds and pests, and more importantly timely uniform and low labour requirement,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Lack of machines • Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Lack of facilitation for demonstration • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	KES 280,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• The direct drill will reduce the drudgery of work for the various gender categories (men, women) who perform the tasks of making of holes and planting activities. • Women and youth have limited access credit to purchase the direct drill. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • 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	• 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W. W.

2.9.7 TIMP Name	**Kales Trans planter**
Category (i.e. technology, innovation or management practice	 Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow and tedious processes of seedling placement • Inconsistent planting depth and soil firming • Delayed operation lead to late planting • High cost of manual Labour
What is it? (TIMP description)	A Kales seedling trans planter is a device used in agriculture that opens furrows meters, sow seedlings for Kales by positioning them in the soil and burying them to a specific depth without forming a ridge along the seed row. The

	Kales trans planter places seedlings at the proper seeding rate and depth.
Justification	• Manual planting increase the amount of seed used and may require thinning • Fertilizer use is not evenly distributed when manually applied • Kales seedling is small making planting depth critical and difficult to attain when manually done and seedling shallowly planted will fail to pick • Raw planting increases yields, easy to manage weeds and pests, and more importantly timely uniform and low labour requirement,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales farmers and researchers
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Multiple usage, timeliness, efficiency and low cost
Partners/stakeholders for scaling up and their roles	KALRO, Universities (for information) Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Kiambu, Nyandarua
Challenges in dissemination	• Lack of facilitation for demonstration • High initial cost for small-scale machines
Suggestions for addressing the challenges	• Acquisition of the machines • Facilitate demonstrations • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	• Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations

Social, environmental, policy and market conditions necessary for development and up scaling	• Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 980,000
Estimated returns	KES 180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the transplanting activities so the implement will reduce the drudgery of their work. • Women and youth have limited access to education, training and extension services than men. • Women and youth have limited access credit to purchase the required implements • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs. • 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	• 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W. W.
Partner organizations	Local dealers

2.9.8 TIMP Name	**Seed tray planter**
Category (i.e. technology, innovation or management practice	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Tedious to plant in the trays manually • Manual planting is difficult to calibrate and may allow planting more than one seed in a hole • Manual seed try planting is time wasting

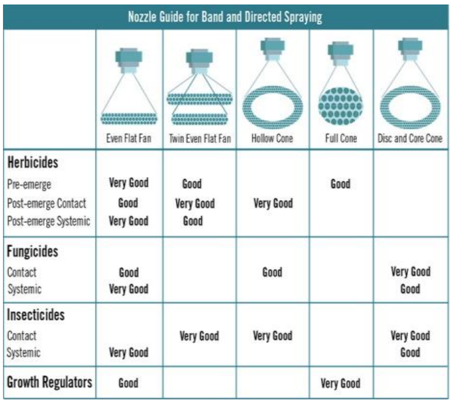
What is it? (TIMP description)	For seeding seeds that needs to be transplanted the machine is able to plant in trays without cells / box seeding, constantly feeding of the seed Speed of seed supply is adjustable; it has a belt of 400 cm long x 40 cm wide with brush for cleaning the top of the trays. The speed of the vibrating bowls is adjustable. Also you can adjust on the top side of the bowl the size of the seeds. The seeds fall down in a pipe that distributes the seeds over the output hoses.
Justification	• Manual Kales seed tray planting can cover low acreage within a stipulated time and may delay due tobad weather • Manual planting labour dependency and require 20 people per hectare while a planter will require only 1 for the same time. • A part from lack of harvesting labour cost is saved by at least 70 percent
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales Farmers and agribusiness entrepreneurs

Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Marsabit, Kiambu, Narok
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. Good Policy on cost of agricultural mechanization

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Kales seed try planter 725,000 KES per unit
Estimated returns	Capacity 1 seedling/ 3 seconds, Needs one operators per time Planting charges: KES 1 per bag Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women perform most of the crops activities so the implement will reduce their work burden. • Women and youth have limited access to education, training and extension services than men. • Women and youth have limited access credit to purchase the required implement. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs. • VMGs have limited access to credit to purchase the farm implement. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	• Opportunities exist for unemployed 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	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization	KALRO, Egerton University,
and scientists	Nasirembe W,
Partner organizations	Local Fabricators
VMG issues and concerns in development, dissemination, adoption and scaling up	• Training on local use and transportation will make it more usable. • Kales harvester is affordable and could help VMGs exploit
VMG related opportunities	Can create employment for VMG at local level
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Nasirembe W Egerton University,
Partner organizations	Tecsols Ltd - Nakuru

2.9.9 TIMP Name	**Motorised Sprayer**

Category (i.e. technology, innovation or management practice)	Technology  
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Slow • Tedious processes of manual spraying
What is it? (TIMP description)	A motorized sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers are manportable units typically backpacks with spray guns They are used to control weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants, boron e.g. as well as foliar fertilizers
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before Kales forms a canopy, broad leafed weeds compete with Kales seedling for nutrients and light greatly reducing their yield. Manual sprayer is labour intensive and spraying labour is too expensive. It has lower presser reducing its efficiency
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training
Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Kiambu, Narok, Nyandarua

Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development, dissemination, adoption and scaling up	• Men perform most of the spraying activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the motorized sprayer. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce men's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • 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	• Opportunities exist for unemployed youth males 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	Mechanization has enabled increased production in other crops such as maize, wheat, finger millet and rice
Application guidelines for users	• Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI –Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.9.10 TIMP Name	**Fertilizer spreader**

Category (i.e. technology, innovation or management practice)	Technology 
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Top up balance for nitrogen manually will not be uniformly distributed • Untimely spreading • High cost of labour • Low labour productivity
What is it? (TIMP description)	A broadcast fertilizer, alternately called a broadcaster, broadcast spreader or centrifugal fertilizer spreader, is a farm implement commonly used for spreading seed, lime, fertilizer, sand, ice melt, etc., and is an alternative to drop spreaders/seeders.
Justification	• Manual fertilizer application can cover low acreage within a stipulated time and may delay • Manual fertilizer application is labour dependent and require 20 people per hectare while a broadcaster will require only 1. • A part from lack of fertilizer application cost is saved by at least 60 percent more than machine
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Kales Farmers and agribusiness entrepreneurs
Approaches used in dissemination	Field Demonstrations, exhibitions, agricultural shows (ASK) and training

Critical/essential factors for successful promotion	Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Narok, Marsabit, Kiambu
Challenges in dissemination	• Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	• Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Seed tray planter 125,000 KES per unit
Estimated returns	Capacity k / hour, Fuel 1 litre /hr (4-5 bags) 500 Needs 3 c ges: KES 300 per bag time ason to return the KES 125,000 purchase price
Gender issues and concerns in development ,dissemination, adoption and scaling up dissemination	Seed tray planter designed for easy start and operation. Men have been drawn to Kales threshing by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet
Estimated returns	Not yet

Gender issues and concerns in development, dissemination, adoption and scaling up	• The fertilizer spreader will reduce the drudgery of work for the various gender categories (men, women) who perform the task of spreading fertilizer. • Women and youth have limited access to credit to purchase the fertilizer spreader. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	• Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	• Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • 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	• Opportunities exist for unemployed youth males 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	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	• Demonstrations and training • User manuals

F: Status of TIMP readiness (1-ready for upscaling;, 2requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University, Nasirembe W,
Partner organizations	Local Fabricators

Gaps for further research

1 Equity distribution in income among the stakeholders
2 Productivity levels among the smallholder farmers
3 Farmer accessibility to production inputs
4 Sustainability of the Kale industry

2.10 KALE FARMING BUSINESS AND MARKETING

2.10.1. TIMP Name	**Transformative Model of kale production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Most of the kale producers have small production units with limited use of improved inputs. This leads to low kale productivity. Low productivity leads to poor market access.
What is it? (TIMP description)	An approach to transform smallholder farmers from low improved inputs to high and therefore build market linkages. At the fully commercial level, inputs are accessed from the markets and outputs solely for the markets.
Justification	Market failures or missing markets of Kale have led to disorganization in Kale production. Due to the disorganization in production of Kale, smallholder farmers fail to access markets or have limited market linkages. Therefore, this model aims at linking farmers to markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions, Universities, policy makers
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups

Critical/essential factors for successful promotion	• Availability of traders and other upstream actors • Acceptance of smallholder farmers to form production organizations • Investments in the production of quality tradable volumes • Acceptance of the Kale varieties by consumers • Adaptability of the Kale varieties • Prices of Kale • Availability of storage infrastructure and transport
Partners/stakeholders for scaling up and their roles	• Farmers – Formation of production groups, investments in Kale production • County extension staff - Organization of farmers and technical service delivery • NGOs – Organization of farmers and service delivery • Private sector (local traders and exporters) – Support in input services and providing markets for the Kale production • Research institutions – Availing improved seeds, backstopping
C: Current situation and future scaling up	
Counties where already promoted if any	In all counties in Kenya but at varying levels
Counties where TIMPs will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu Tranzoia, Kisumu Marsabit West Pokot
Challenges in development and dissemination -	• Disorganization and scattered Kale producers • Small-scale farming • Inadequate information to stakeholders on the Kale varieties • Group dynamics • Lack of seeds • Weak or non-existent stakeholder innovation platforms • Fluctuations in Kale prices • Levels of production constraints • Level of policy support
Suggestions for addressing the challenges	• Strengthen the Poor and weak linkages among the stakeholders • Disorganization and scattered farmers – Formation of production farmer groups • Small-scale farming – allocation of more land to Kale production and aggregation of production to assume large scale-farming. Improved productivity • Inadequate information to stakeholders on the Kale 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

	• Limited supply of demanded seed varieties – Engagement seed companies for supply of demanded seed • Capacity building of farmers on seed production • Weak or non-existent stakeholder innovation platforms – Formation of Kale innovation platforms • Capacity building stakeholders on elements of innovation platforms • Low and fluctuating Kale prices - Value addition, organized marketing channels, producer organizations, capacity building on the reduction of production costs, capacity building on farming as a business • Levels of production constraints – improving credit accessibility, enhancing adoption of Kale TIMPs • Level of policy support – Lobbying for the County government support in policy formulations
Lessons learned in up scaling if any	• There is need to have an all inclusive enhance value addition in Kale production to increase profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – acceptability by the farmers, group dynamics, cultures to have value added products • Environmental conditions – Enhancing natural resource management • Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives),infrastructure, investment environment
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Women are widely discriminated in rural producer organizations that are linked to markets. • Women have limited access to markets than men.
Gender related opportunities	• Men and youth stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs are widely discriminated in rural producer organizations that are linked to markets.
VMG related opportunities	• VMGs stand to benefit with higher profit margins through collective bargaining and marketing • Opportunities exist for unemployed youth in production and marketing through ICT
E: Case studies/profiles of success stories	
Success stories from previous similar projects	High yielding Kale hybrid seed bought by the county government of Marsabit and other counties

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)	The Kale production organization by buyers are ready for up-scaling
G: Contacts	
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Partner organizations	- Extension service providers - CGIAR's NGOs

GAPS

Further research

1 Evaluating efficiency of the farmer-market linking and business models
2 Equity distribution among the producers
3 Productivity levels among the smallholder farmers due to farmer-market linking models
4 4 Farmer accessibility to production inputs

2.10.2. TIMP Name	**Building a Business Plan for Kale production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Unplanned and traditional production of kale leads to lack of production targets, losses and market failure.

What is it? (TIMP description)	A business plan is a document guiding the operations in a business. The document contains details such as iintroduction, business organization, product, marketing strategy, risks, business operation plan, marketing costs, income streams, profit and loss analysis and financial requirements
Justification	A business without a plan cannot identify its strengths, weaknesses, opportunities and threats. Guided by a business plan, farmers will not analyse opportunities, explore options, select the best option, detailed planning and implementation. There are many opportunities in Kale production, processing and marketing. However, the achievement of the best opportunity would depend on the analysis of strength, weaknesses and threats.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Traders, processors, NGOs, Extension agents, policy makers and implementers
Approaches to be used in dissemination	Trainings, factsheets, manuals and seminars
Critical/essential factors for successful promotion	• Education levels of the Kale farmers and other actors • Levels of experiences in Kale production • Availability of information on Kale production and marketing • Supporting policies and regulations
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding opportunities • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders, processors and exporters) – Demanding opportunities • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	• Upgrading of the value chain demands looking ate strengths, weakness and opportunities along the Kale value chain segments
Counties where TIMPs will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu Tranzoia, Kisumu Marsabit and West Pokot
Challenges in development and dissemination	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Kale production and marketing • Levels of strengths, weaknesses and Threats in Kale production and marketing • Levels of policy support

Suggestions for addressing the challenges	• Formation of production groups • Allocation of more land to Kale production and aggregation of production to assume large scale-farming • Developing a Kale information hub • Sensitization of stakeholders on kale production challenges • Support in extension services
Lessons learned in up scaling if any	• Need to address the challenges in Kale production to enhance benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming in the climate change situations • Environmental conditions – Use of opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• High illiteracy levels of women leading to lack of record keeping and poor records
Gender related opportunities	• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to come up with good business plan.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Some of the VMGs are illiterate hence cannot keep good records
VMG related opportunities	• Being a high value crop, opportunities exist for youth since they are highly literate and can be able to come up with good business plan.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Narok, Kiambu, Nakuru and Nyandraua county have done well
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)	The matrices are ready for up-scaling
G: Contacts	
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

1 Software for running the SWOT matrix
2 Efficiency in identifying the opportunities
3 Performance of the opportunities

2.10.3. TIMP Name	**Profitability analysis**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The problem of failure of profitability analysis is common among the smallholder farmers of kale. This leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise in terms of low productivity and income
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the kale agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain
Justification	• Profitability analysis reviews the management success and sustainability of the Kale business. It indicates areas of adjustment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents, policy makers
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT

Critical/essential factors for successful promotion	• Production programme • Availability of data on quantities of inputs requirements, costs, outputs and value
Partners/stakeholders for scaling up and their roles	• Farmers – Defining production programme • County extension staff - Capacity building • NGOs – Capacity building • Research
C: Current situation and future scaling up	
Counties where already promoted if any	All 47 counties but at varying levels
Counties where TIMPs will be up scaled	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu Tranzoia, Kisumu Marsabit West Pokot
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the Kale production and marketing • Defining production programmes of Kale • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – allocation of more land to Kale production and aggregation of production to assume large scale-farming • Inadequate information to stakeholders on the Kale production – Developing information hub • Defining production programmes of Kale • Level of policy support – support in extension services
Lessons learned in up scaling if any	• Majority of farmers do not keep records
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional Kale production • Environmental conditions – Opportunities with effects of degrading natural resource management • Policy conditions – Policy support in specific value chain segments
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• High illiteracy levels of women leading to lack of record keeping and poor records

Gender related opportunities	• Being a high value crop, opportunities exist for youth to keep records and do the required mathematics
VMG issues and concerns in development and dissemination, adoption and scaling up	• Some are illiterate hence cannot keep good records
VMG related opportunities	• Youths have an opportunity to venture in this enterprise since they literate hence can be able to do the required mathematics.
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)	Formats for record keeping, gross margin, break-even, Benefit-cost ratios are ready for up-scaling
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

1. Software for running the budgets
2. Profitable opportunities
3. Effects of record keeping

2.10.4. TIMP Name	**Marketing Innovation model for the Kale Production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	As farmers produce and market kale, they fail to follow business principles including marketing strategies in farm operations and farm activities geared toward making a profit
What is it? (TIMP description)	Production and marketing innovation encompasses entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit. An entrepreneur farmer undertakes innovations and finance a business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of kale, the market outlook will be Farmers become entrepreneurs when business principles are applied in farming practices to make businesses successful. Failure to apply business principles in farming leads to unsuccessful.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers., traders
Approaches to be used in dissemination	Trainings, factsheets, manuals, Radio, TV, ICT
Critical/essential factors for successful promotion	• Organization of farmers • Availability of innovations • Achievement of profit • Access to finance • Availability of facilitators • Availability of many traders • Production volume and quality
Partners/stakeholders for scaling up and their roles	• Farmers – Acceptability of innovations • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders, processors, and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	All counties but at varying levels
Counties where TIMPs will be up	Nyandarua, Kiambu, Nyeri, Kisii, Kericho, Nandi, Bungoma Kisumu Transzoia, Kisumu Marsabit West Pokot

scaled	
Challenges in development and dissemination -	• Small-scale farming • Availability of information • Profitability in Kale farming • Levels of policy support
Suggestions for addressing the challenges	• Small-scale farming – capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support
Lessons learned in up scaling if any	• Reduced cost of production, increased profit
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional methods • Environmental conditions – Use of pesticides and disposal • Market conditions – Contract farming, access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Women lack entrepreneurial skills and capacity to engage in entrepreneurship compared with men • Women lack basic reading and numeracy skills so they can run their businesses compared with men • Women do not know how to save their money that can be used in entrepreneurship compared with men • Women do not usually apply for loans that can be used to manage their businesses and increase their profits due to lack of collateral compared with men
Gender related opportunities	• Opportunities exist for women to venture in entrepreneurship through the women enterprise fund.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs lack basic reading and numeracy skills so they can run their businesses • VMGs lack the business acumen • VMGs lack the starting capital
VMG related opportunities	• Opportunities exist for VMGs to venture in entrepreneurship through affirmative action funds that are given to them e.g. Uweso fund etc.
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Available innovations are ready for up-scaling
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Partner organizations	- Extension service providers - CGIAR's - NGOs

Gaps for further research

1. Efficacy and suitability of various chemicals
2. Sustainability based on market prices
3. Innovations for the increased productivity

2.10.5. TIMP Name	**Collective marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Lack of bargaining power and volumes for sale
What is it? (TIMP description)	A marketing or producer organizations formed by farmers

Justification	Poor farmers in many remote areas do not understand how the market works or why prices fluctuate; they have little or no information on market conditions, prices and quality of goods; they are not organized collectively; and they have no experience of market negotiation and little appreciation of their capacity to influence the terms and conditions upon which they enter the market. Difficult market access restricts opportunities for income generation. Farmer organization provides relevant data to help solve marketing challenges.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Barazas, Trainings, Factsheets, Manuals, Field days, ICT, Radio.
Critical/essential factors for successful promotion	• Organization of farmers • Availability of facilitators • Availability of many traders • Production volume and quality • Trust • Innovativeness
Partners/stakeholders for scaling up and their roles	• Farmers – Organization of groups • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators • County government – Policy support
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui ,Marsabit and West Pokot
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Availability of information • Levels of policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of producer organization • Small-scale farming – allocation of more land to Kale production and aggregation of production to assume large scale-farming, improved productivity • Availability of information – Capacity building of producer groups • Policy support – Engagement with the county government

Lessons learned in up scaling if any	• Reduction of transaction costs leading to increased profits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Producer group by-laws to govern the operations, Groups to be business oriented • Environmental conditions – Depleted soil nutrients due over-use of cultivated land and pollution due to use of pesticides • Policy conditions – Available policy support
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Women are widely discriminated in rural producer organizations • Women also have limited participation and influence in rural producer organizations • 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	• Opportunities exist for the various gender categories to benefit from higher profit margins through collective bargaining during marketing. • Opportunities exist for unemployed youth in collective marketing through ICT
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs are widely discriminated in rural producer organizations • VMGs also have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	• VMGs stand to benefit with higher profit margins through collective bargaining and marketing • Opportunities exist for unemployed youth in collective marketing through ICT
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)	Marketing as a group guidelines are ready for use if provided

G: Contacts	
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Partner organizations	- Extension service providers - CGIAR's - NGOs

Gaps for further research

1. Performance of marketing organization
2. Sustainability of the management of the organization
3. Equity distribution in sales and income

2.10.6 TIMP Name	**Contracted production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Markets failure in Kale production has led to low price, low production and poor quality
What is it? (TIMP description)	Contract farming involves private companies extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.

Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, extension, research institutions, farmer cooperative societies
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media
Critical/essential factors for successful promotion	• Willing farmers • Availability of traders • Competitiveness of Kale • Production volume • Enforcement and bidding contract farming
Partners/stakeholders for scaling up and their roles	• Farmers – Contract party and beneficiaries • County extension staff - Capacity building, signing contract • NGOs – Capacity building • Private sector (local traders and exporters) – Contract party and beneficiaries • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui, Marsabit and West Pokot
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Lack of information by part of the producers • Level of policy support

Suggestions for addressing the challenges	• Disorganization and scattered farmers – Formation of production clusters • Small-scale farming – Increase volume through increase in productivity • Lack of information by part of the producers – Capacity building • Level of policy support – County policy formulation and enforcement for contract farming
Lessons learned in up scaling if any	Increased benefits
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Conflicts with traditional farming • Environmental conditions – reduced environmental pollution through safe use of agro-chemicals, Input support in the contract improves natural resource management • Policy conditions – Policy in formulation and enforcement • Market conditions – volume, place, price, promotion,
	traders
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Women have less access to knowledge and information on contract farming than men. • Women have less access to land for farming than men.
Gender related opportunities	• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have less access to knowledge and information on contract farming. • VMGs have less access to land for farming.
VMG related opportunities	• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides

F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	The guidelines for the contract farming are ready for upscaling
G: Contacts	
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Partner organizations	- Extension service providers - CGIAR’s NGOs

Gaps for further research

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

2.10.7. TIMP Name	**Internet/mobile marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor market access due to constraints in marketing channels, skills and market information
What is it? (TIMP description)	Internet marketing refers to the strategies used to market products and services online and through other digital means. These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet marketing is increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	• Education levels of the farmers and investors in Kale production and profitability analysis • Levels of experiences in Kale production • Availability of information on Kale production and marketing
Partners/stakeholders for scaling up and their roles	• Farmers – Sellers of Kale produced • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of Kale • 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	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui , Marsabit and West Pokot
Challenges in development and dissemination -	• Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the Kale production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	• Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the Kale production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in up scaling if any	• Requires stakeholders involvement • Remains the best cost effective option for marketing in terms of searching for the market information

Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – low levels of adoption of information technology • Environmental conditions – improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Women have less access to the required tools such as phones and computer than men. • Women are more illiterate and therefore cannot use the ICTs compared with men.
Gender related opportunities	• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have the phones or the computer.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs have less access to the required tools such as phones and computer. • VMGs are more illiterate and therefore cannot use the ICTs
VMG related opportunities	• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have the phones or the computer.
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)	The platforms are ready for up-scaling
G: Contacts	
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

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

2.10.8. TIMP Name	**5.6 Market research**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Farmers' lack of market information on outlets and prices of Kale
What is it? (TIMP description)	An approach by farmers to gather market information
Justification	The rural poor are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power they require to interact on equal terms with other, generally larger and stronger, market intermediaries. Cultural and social distance, and discrimination, may also be factors that at least partly exclude the poor from markets. Therefore participatory market research will assist farmer to gain knowledge on the structure and performance of markets leading to higher profit.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension, research institutions
Approaches to be used in dissemination	Barazas, trainings, factsheets, manuals, media, ICT
Critical/essential factors for successful promotion	• Availability of County policies • Willingness of farmers • Availability of targeted markets • Access to markets

Partners/stakeholders for scaling up and their roles	• Farmers – participants in market research • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui and Marsabit county
Challenges in development and dissemination -	• Disorganization and scattered farmers • Small-scale farming • Inadequate information on the Kale and Kale - byproducts market outlets. • Lack of skills in the use of communication technologies • Group dynamics
	Policy support
Suggestions for addressing the challenges	• Disorganization and scattered farmers – Organization of producer groups for cooperate marketing. • Small-scale farming – Increase hectarage under Kale production, improving productivity and aggregation of produce to achieve large volume for the market • Inadequate information to stakeholders on the Kale 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	Improved marketing strategies
Social, environmental, policy and market conditions necessary for development and up-scaling	• 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	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150

Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of women and youth in market research. • Women have less access to market information than men.
Gender related opportunities	• Employment opportunity exist for educated youths in market research
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs also have limited participation in market research. • VMGs have less access to market information
VMG related opportunities	• Employment opportunity exist for educated youths in market research.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Barazas, training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	The guidelines for the participatory market research are ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

1 Performance of participatory market research process

2 Production and marketing efficiency in KALE due to the participatory market research process

3 Equity distribution in income and change in livelihood

2.11 AGRICULTURAL POLICY OPTIONS

2.11.1. TIMP Name	**National Agricultural Strategies Framework supporting Kale production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provide objectives
What is it? (TIMP description)	National Agricultural policy framework includes policies that have framed smallholder farmers, as poor with no agencies and voices. The policies focus on large scale farmers. The National Agricultural policy framework provides objectives.
Justification	Agricultural policy making in Kenya overlooks diverse agricultural transformation pathways that are sustainable in local social/material conditions and based on smallholder farmers' knowledges leading to the unmet stated objectives of policy, to reduce poverty by building smallholder livelihoods and increasing agricultural productivity, are not met. We consider the pathways through which smallholder farmers' perspectives and knowledge can be included in policy going forward
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter,email), internet, farmers' groups
Critical/essential factors for successful promotion	• Availability of stakeholders • Availability of specific Kale-based policies
Partners/stakeholders for scaling up and their roles	• Farmers – Demanding Kale policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Kale policies to support production and marketing • Research institutions – Sensitization of stakeholders

C: Current situation and future scaling up	
Counties where already promoted if any	
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui
Challenges in development and disemination -	• Value Chain: Kale yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • Standards: Existing standards at the production level are poorly defined and implemented, and largely do not include environmental or CSA criteria. Voluntary certifications are piecemeal and not widely adopted. • Aggregation: Aggregation models including cooperatives—suffered after the downturn in Kale production, wherein many farmers abandoned Kale production. These weak organizations provide few services to farmers while providing limited bargaining power. • Financial Incentives: The government provides only limited support to Kale producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs). Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards. •

Suggestions for addressing the challenges	Value Chain: Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors. Standards: Existing Kale standards and classifications should be redesigned to align with Kenya's climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training. Aggregation: Partnerships between farmer cooperatives and Kale producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs. Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based Kale payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – Traditional farming of Kale where there is no value chain • Environmental conditions – Use of pesticides • Policy conditions – Lacking specific Kale policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and

	validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation and upscaling
G: Contacts	
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

1 Adoption of policies
2 Equity distribution among the stakeholders
3 Productivity levels among the smallholder farmers due to farmer-market linking models
4 4 Farmer accessibility to production inputs

2.11.5. TIMP Name	**County Integrated Development Plan for supporting Kale production and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor performance of Kale sub-sector in the country leading to low Kale production/ productivity and income
What is it? (TIMP description)	The Country Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in Kale production, marketing and processing are considered. ..
Justification	Agriculture is the main economic activity in the Country. This has significant implications on income generation, food security and poverty reduction efforts in the country. Therefore Kale is a major cash crop considered in the all the counties integrated development plan (CIDP). Failure to consider Kale issues during planning would lead to omission in the development funding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Sensitization of stakeholders in the Kale value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders Universities
C: Current situation and future scaling up	
Counties where already promoted if any	All Counties in Kenya
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui

Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming • Inadequate information by the stakeholders on the CIDP
Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP Environmental conditions – sustainability of the community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.

E: Case studies/profiles of success stories	
Success stories from previous similar projects	The project offers support to all categories of Kale producers including the VMGs
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	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
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Partner organizations	- Extension service providers - CGIAR’s NGOs

Gaps for further research

1. Equity distribution among the stakeholders
2. Productivity levels among the smallholder farmers due to CIDP
3. Farmer accessibility to production inputs
4. Improvement on households’ livelihood

2.11.5. TIMP Name	**Policy instruments related to Kale production**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The existing policy instruments do not centralize the smallholder farmers issues in kale production. Therefore, weak policy instruments lead to market failure for both inputs and outputs

What is it? (TIMP description)	Agricultural policy is implemented through instruments which are the intervention points. Therefore, the policy instruments are the means to achieve policy objectives
Justification	Without policy instruments related to kale production, farmers will remain without support in the agro-enterprise and market development. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability may lack centralization of the smallholder farmers agency and voices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmer cooperatives, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	• Sensitization of stakeholders in the Kale value chain • Availability of County Integrated Development Plan
Partners/stakeholders for scaling up and their roles	• Farmers – Participants in the development and implementation of the CIPD and also provide production and marketing data • County extension staff - sensitization of stakeholders, farmers included • NGOs – sensitization of farmers • Private sector (local traders and exporters) – participants and provide data on their achievements and concerns • Research institutions – sensitization of stakeholders Universities
C: Current situation and future scaling up	
Counties where already promoted if any	All Counties in Kenya
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui
Challenges in development and dissemination -	• Lack of organization of farmers • Low participation • Small-scale farming • Inadequate information by the stakeholders on the CIDP

Suggestions for addressing the challenges	• Lack of organization of farmers - Formation of producer organizations as an institution • Low participation – create awareness on the importance of the CIDP document • Small-scale farming – options for increasing productivity • Inadequate information to stakeholders on the CIDPs – well informed farmers to participate in the development of CIDP
Lessons learned in up scaling if any	The interests of agricultural communities are addressed in the CIDP
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – inclusion in the participation while developing and implementing CIDP • Environmental conditions – sustainability of the
	community projects • Policy conditions – Available CIDP document • Market conditions – Support commercialization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The project offers support to all categories of Kale producers including the VMGs
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	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

5. Equity distribution among the stakeholders
6. Productivity levels among the smallholder farmers due to CIDP
7. Farmer accessibility to production inputs
8. Improvement on households' livelihood

2.11.6. 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	Lack of Kale specific policy leading to low productivity due to low adoption of quality inputs and poor marketing channels
What is it? (TIMP description)	Policy cycle involves problem definition or concerns, formulation, implementation and evaluation components

Justification	Policy cycle is used in the formulation and implementation of agricultural policies for the agriculture and rural development. Due to lack of Kale policy, policy cycle can be used in the formulation and implementation and evaluation of outcome. Kale value chain has specific policy concerns which can be identified at the stage of problem definition in the policy cycle. The issues are addressed at the implementation stage. As the implementation goes on, there is need for an evaluation at the evaluation stage to determine the success of the policy. The cycle completes by the establishing of the failure in to achievement the objectives or goals of the development agenda.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Public participation meetings
Critical/essential factors for successful promotion	• Availability of stakeholders • Kale policy concerns • Level of understanding of stakeholders
Partners/stakeholders for scaling up and their roles	• Farmers – provide information on the problems in the Kale value chain • County extension staff - sensitization of stakeholders • NGOs – sensitization of stakeholders • Private sector (local traders and exporters) – provide information on the problems in the Kale value chain • Research institutions – sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	Kiambu,Nyandarwa,Nyeri,Kisii,Kericho,Taita,Taveta,Bungoma,Nakuru,,Elgyo Marakwet ,Narok, Machakos, Kitui
Challenges in development and dissemination -	• Lack of spearheading in the policy formulation • Lack of organized forums • Inadequate information to stakeholders • Poorly established Kale value chain
Suggestions for addressing the challenges	• Lack of spearheading in the policy formulation – the agricultural department in the county should take the initiative to ensure Kale specific policy is in place • Lack of organized forums - formation of stakeholder forums consisting of well-informed participants. • Inadequate information to stakeholders – sensitization of stakeholders • Poorly established Kale value chain – active participation by the actors in the Kale value chain.

Lessons learned in up scaling if any	For the Kale industry to progress, there is need for a KALE specific policy
Social, environmental, policy and market conditions necessary for development and up-scaling	• Social conditions – social inclusion • Environmental conditions – environmental conservation strategies to be highlighted in the policy • Policy conditions – to ensure Kale specific policy is formulated and implemented • Market conditions – within the policy framework
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	On average the basic costs amount to Ksh 103,850
Estimated returns	Estimated returns after deductions of variable costs are Kshs 121,150
Gender issues and concerns in development and dissemination, adoption and scaling	• Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	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	
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Partner organizations	- Extension service providers - CGIAR's NGOs

Gaps for further research

1 Equity distribution among the stakeholders
2 Productivity levels among the smallholder farmers
3 Farmer accessibility to production inputs.
4 Sustainability of the Kale industry

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