INVENTORY OF CLIMATE SMART AGRICULTRE BANANA TECHNOLOGIES, INNOVATIONS & MANAGEMENT PRACTICES

Kenya Agricultural and Livestock Research Organization

Under

KENYA CLIMATE SMART AGRICULTURE PROJECT (KCSAP)

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1.0 Definition of terms and summary tables of Banana Technologies, Innovations and Management Practices (TIMPS)

1.1 Definition of terms

Technology: This is defined as an output of a research process which is beneficial to the target clientele (mainly farmers, pastoralists, agro-pastoralists and fisher folk 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 defined as recommendation(s) on practice(s) that is/are considered necessary for a technology to achieve its optimum output. These include, for instance, different agronomic and practices (seeding rates, fertilizer application rates, spatial arrangements, planting period, land preparation, watering regimes, etc.), protection methods, for crops; and feed rations, management systems, disease control methods, etc. for animal breeds. This is therefore important information which is generated through research to accompany the parent technology before it is finally released to users and the technology would be incomplete without this information.

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

1.2 Summary of Inventory of TIMPs in the Banana Value Chain

The inventory process resulted in a total of 39 TIMPs including 26 technologies, one innovation, and 12 management practices, distributed among the three sub-themes, as indicated in Table 1

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Banana	Propagation	4	0	1
Banana	Improved varieties	14	0	0
Banana	Agronomic practices	0	1	11
Banana	Postharvest	2	0	0
	Value addition	6	0	0
Overall Total		**26**	**1**	**12**

1.3 Summary of Status of TIMPs in Banana Value Chain

The inventory process resulted in a total of 28 TIMPs that are ready for up scaling, 4 TIMPs that require validation and 5 TIMPs that require further research in the sub-themes, as indicated in Table 2.

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

Commodity/VC	Sub-Theme	Ready for upscaling	Require validation	Further Research
Banana	Propagation	3	0	1
Banana	Improved varieties	14	0	0
Banana	Agronomic practices	10	3	1
Banana	Post-harvest and	0	1	1
Banana	Value addition	4		2
Overall Total		28	4	5

Table3: Inventory of Banana TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
Propagation	2.1.1 Tissue culture	Technology	Ready for up-scaling
	2.1.2 Hardening Nursery	Technology	Ready for up-scaling
	2 .1.3 Low cost tissue culture propagation method	Technology	Further research
	2.1.4 Macro propagation	Technology	Ready for up-scaling
	2.1.5 Pairing and hot water treatment	Management practice	Ready for up-scaling
Improved varieties	2.1.6 Drought tolerant banana varieties	Technology	Ready for up-scaling

	2.1.7 Black Sigatoka tolerant varieties	Technology	Ready for up-scaling
	2.1.8 Medium height varieties	Technology	Ready for up-scaling
	2.1.9 Panama tolerant varieties	Technology	Ready for up-scaling
	2.1.10 High yielding and market preferred varieties	Technology	Ready for up-scaling
	2.1.11 Clean high yielding tissue culture	Technology	Ready for up-scaling
	2.1.12 Grand Naine	Technology	Ready for up-scaling
	2.1.13 Giant Cavendish	Technology	Ready for up-scaling
	2.1.14 Valery	Technology	Ready for up-scaling
	2.1.15 FHIA 17	Technology	Ready for up-scaling
	2.1.16 FHIA 23	Technology	Ready for up-scaling
	2.1.17 Ngombe	Technology	Ready for up-scaling
	2.1.18 Uganda Green	Technology	Ready for up-scaling
	2.1.19 Mbolokama	Technology	Ready for up-scaling
Management practices	2.2.1 Integrated soil management practices	Management practice	Ready for up-scaling
	2.2.2 Mulching	Management practice	Ready for up-scaling
	2.2.3 Intercropping	Management practice	Ready for up-scaling
	2.2.4 Zai pit	Management practice	Validation
	2.2.5 Drip irrigation	Management practice	Validation
	2.2.6 Green manure	Management practice	Further Research
	2.2.7 ABCC BXW management	Management practice	Ready for up-scaling
	2.2.8 Organic+ inorganic fertilizers	Management practice	Further research
	2.2.9 Inorganic fertilizer	Management practice	Ready for up-scaling
	2.2.10 IPDM	Management practice	Ready for up-scaling
	2.2.11 Weevil control	Management practice	Ready for up-scaling
	2.2.12 Nematodes control	Management practice	Ready for up-scaling
Postharvest	2..3.1 Banana bagging	Technology	Validation
	2.3.2 Banana handling and storage	Technology	Ready for up-scaling
Value addition	2.4.1 Banana flour	Technology	Ready for up-scaling
	2.4.2 Fried banana chips	Technology	Ready for up-scaling
	2.4.3 Banana crisps	Technology	Ready for up-scaling
	2.4.4 Banana uji flour	Technology	Ready for up-scaling
	2.4.5 Banana wine	Technology	Further research
	2.4.6 Banana Jam	Technology	Further research

3 Detailed Banana value chain TIMPS

2.1 Improved banana varieties for food security, processing and economic growth

2.1.1 TIMP name	**Tissue culture banana technology**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low banana productivity due to unavailability of clean planting materials.
What is it? (TIMP description)	This is a propagation method for the production of clean (pest and disease free) planting material, with uniform flowering and maturity that are thus suitable for contract marketing
Justification	Banana is an important crop in Kenya used for food and income generation. Pests and disease are a major challenge to banana production, causing significant losses in yields and quality. This is occasioned by inadequate clean planting material and a high genetic variability of available planting materials. Most farmers recycle their own planting materials which are mostly diseased and pest infested thus have low vigour for good planting material. These materials are also not of uniform size and age. Tissue culture provides a method of rapidly multiplying clean uniform planting material with high vigour and good chances of high survival rates after establishment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmer producer groups, and farmers.
Approaches used in dissemination	Hands on demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	• Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation • Evidence for market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • KU-Will provide backstopping on plant health issues and low cost tissue culture protocol • Community farmer groups will provide land for demonstration on banana production and enhance spread of knowledge through farmer to farmer training.

	• NGOs such as world vision, Africa Harvest will provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia,Embu, and Siaya.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of clean planting materials - Erratic weather patterns due to climate change - High cost and inadequate funds to purchase planting materials - Centralized TC laboratories without an effective distribution network
Suggestions for addressing the challenges	- Lower the cost of seedling - Provision of drought tolerant banana planting materials - Create incentive for private sector to set up labs in western and eastern Kenya - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage ensures success of the project e.g. subsidizing cost of seedling production - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology - Create effective linkages within the value chain to the end consumer
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity. • Enabling policy frameworks, e.g. Big 4 Agenda that requires the blending of high nutritive value food products.
Basic costs	80/- per seedling
Estimated returns	120/- per seedling

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination adoption and scaling up	• Gender inequalities in regard to access and control over the resources such as land and capital • Existing cultural practices which allow men alone to plant bananas • Perceptions in regard to banana as a snack food • The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • It offers opportunities in enhancing food security with the rural households and as source of income
VMG issues and concerns in development, dissemination, adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	More than Twelve million TC bananas have been distributed to farmers in the past ten years. This has led to increased production, improved income and food security in major producing areas such as kisii, Meru, nyeri and Taita taveta. The increased production has provided raw material for value addition and processing banana products
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	www.agrifarming.in/banana-tissue-culture-information

	www.africenter.isaaa.org/wp-content/uploads/2015/12/TC-Banana-Booklet.pdf
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Need to fine-tune TC protocol for cooking bananas and plantains
- Study on demand of TC material for sustainable production and supply
- Social economic study on profitability, market demand of tissue culture bananas

2.1.2 TIMP name	**Hardening Nursery**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low banana productivity due to poor plant establishment attributed to low adaptability of TC seedlings to local conditions • TC seedlings to reach transplanting size.
What is it? (TIMP description)	This is a structure with at least 55% netting roof to reduce sunlight and temperature, with insect proof net to protect from pest attack, uses sterilized potting media to enhance root formation and vigorous growth before transplanting. Plants remain in the structure for at least two months.
Justification	Banana is an important crop in Kenya used for food and income generation. However there is inadequate clean planting material and guarantee of true to type. In addition to this the distribution of clean planting material is poor thus farmers and producer groups cannot access these materials from TC Labs and Macro propagation units. Establishment of Hardening nurseries will ensure availability of quality planting material to farmers and producer groups.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Youth groups, Farmer producer groups, commercial entrepreneurs, VMG
Approaches used in dissemination	Hands on demonstration, farmer field days, group to group extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	• Good security • Availability of clean water • Be in an area where bananas are grown

	• Timely availability of planting materials, training of trainers, favorable weather and provision of supplementary irrigation • Evidence for market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO will demonstrate the technology. • KALRO – will train trainers and provide technical backstopping on dissemination of hardening technology
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia,,Embu, Muranga, Kiambu , Nyeri and Siaya. Homabay
Counties where TIMP will be up scaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Mixing of varieties at the lab - Erratic weather patterns due to climate change - High mortality if plantlets are too young at hardening stage - Centralized TC laboratories without an effective distribution network
Suggestions for addressing the challenges	- Create incentive for private sector to set up hardening nurseries - Collaboration with county government in financing community hardening nurseries - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensure success of the project e.g. subsidizing cost of seedling production - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to laboratories, farmer's groups, credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology - Create effective linkages within the value chain to the end consumer
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity. • Enabling policy environment for production and sale of planting materials

Basic costs	Ksh 70,000 per Unit
Estimated returns	40/- per seedling
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination adoption and scaling up	• Gender inequalities in regard to access and control over the resources • Existing cultural practices which allow men alone to plant bananas • Perceptions in regard to banana as a snack food • The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• The TIMP provides an opportunity for Youths and women to benefit from setting up of hardening nurseries, processing units and banana ripening chambers • Improved productivity will enhance food security and incomes with the rural households.
VMG issues and concerns in development and dissemination adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development and dissemination, thus the technology is not easily adoptable by the VMGs • VMGs face the barrier of accessing resources such as land and credit therefore may not benefit from access to clean planting materials
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to enhanced food and nutrition security in the household including VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Farmers in Kisii region can access clean and high yielding varieties from KALRO Kisii and Okosambu Nursery. As a result they have been able to establish new orchards and expand existing ones and realized increased production.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling

Application guidelines for users	**References** • How to Establish a Tissue Culture Banana Hardening Nursery (Africenter 2008) • TC banana plantlets establishment management in nursery (KALRO Kisii, 2017)
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare, Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, JKUAT, GTL, Mimea International, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

2.1.3 TIMP name	**Low cost Tissue culture propagation method**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	High cost of tissue culture propagation for clean planting materials.
What is it? (TIMP description)	It is the use of alternative low cost, locally available input (media and other pre- hardening procedures and materials) in production of Tissue culture planting materials
Justification	Banana is an important crop in Kenya used for food and income generation. Production however is constrained by inadequate clean planting and high cost of tissue culture bananas. Thus most farmers use their own planting which are diseased and infested by pest. These materials are also not of uniform size and age
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	TC Laboratory operators, Nursery operators
Approaches used in dissemination	Hands on demonstration, farmer field days, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	• Timely availability of suckers, training of trainers, favourable weather and provision of supplementary irrigation • Evidence for market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production.

	• Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • KU- Development and availing of low cost tissue culture protocols • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology is still at research stage hence needs fine-tuning.
Counties where TIMP will be up scaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Acceptance of technology by TC labs - Access to the low cost ingredients
Suggestions for addressing the challenges	- Sensitization, create awareness, demonstrations - Gross margins indicating cost effectiveness of the technology - Create sustainable supply network - Create incentive for private sector to set up and finance low cost labs in western and eastern Kenya - Collaboration with county government in supply of materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Technology has been tested under experimental condition. It has potential for validation and up scaling
Social, environmental, policy and market conditions necessary	Banana is socially acceptable and any technology to increase its production will be readily adopted. adoption of the TIMP in place • 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 domestic and international markets for the commodity.
Basic costs	Shs. 40 per seedling
Estimated returns	100 per seedling
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in development, dissemination, adoption and scaling up	• Gender inequalities in regard to access and control over the resources essential in banana production • Existing cultural practices which allow only men to plant bananas • Perceptions by men regarding banana as a snack food and not a main meal hence men may not benefit from Bananas nutritionally as much as women since they consume less bananas. • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • To ensure success of the innovation households should be targeted not women alone. In this case, women can work in collaboration with their husbands for easy access to land allocations and other resources necessary for establishment of the technology hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women will benefit from setting up of hardening nurseries, processing units and banana ripening chambers • It offers opportunities in enhancing food security and incomes within the rural households
VMG issues and concerns in development, dissemination, adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in	Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to enhanced food and nutrition security for VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	The protocol is developed and has been successfully used to propagate materials under trial conditions Similar protocol has been adopted in other countries such as Asia
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
Application guidelines for users	Yet to be developed

G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors, KU

GAPS

- Validation of the technology
- Development of the guide

2.1.4 TIMP name	Macro propagation method
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity of local planting materials and high cost of clean Tissue Culture materials
What is it? (TIMP description)	This a propagation technique for multiplying true to type banana planting materials from identified disease and pest free selected banana plants. Material for multiplication is obtained from sword suckers, corms, and maiden suckers.
Justification	Banana is an important crop in Kenya used for food and income generation. However there is inadequate clean planting material and tissue culture bananas are costly to most small scale farmers. Thus most farmers use locally sourced planting material which are usually diseased and infested by pests. These materials are also not of uniform size and age and may lead to reduced yields and low quality bananas. Macro-propagation is a low cost propagation technique which would avail affordable and clean planting material.
Region promoted	
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Nursery operators, farmer's groups, youth groups
Approaches used in dissemination	Hands on demonstration, farmer field days, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	• Timely availability of clean suckers, training of trainers, favorable weather and provision of supplementary irrigation • Quality media • Evidence for market demand of planting material

Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmer groups and Nursery operators on Banana macro propagation technique either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice of the technique • KU KALRO Kandara and KALRO Kisii- provide the technology and training of trainers
C: Current situation and future scaling up	
Counties already promoted if any	Kirinyaga, Meru, Kiambu
Counties where TIMP will be up-scaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Understanding and acceptance of the technology by the farmers - Sustainable availability of healthy mother plants - Demand for macro propagated planting material
Suggestions for addressing the challenges	- Sensitization, creating awareness, demonstrations - Avail gross margins indicating cost effectiveness of the technology - Create sustainable supply network - Create incentive for private sector to set up macro propagation units - Establishment and maintenance of mother blocks to provide clean material for macro propagation - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain - Access to funds for mentoring university graduates to start agribusiness such as macro propagation units
Lessons learned in up-scaling if any	- This is a potential technology in addressing the gap in provision of clean planting material as well as an agribusiness enterprise for women and youth groups. - There is demand for affordable clean banana planting material - Farmers should be able to distinguish TC from Macro propagated material
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	230,000
Estimated returns	600,000 every 4 months
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in development, dissemination, adoption and scaling up	• Gender inequalities in regard to access and control over the land resources may hinder women from adopting the technology. .The technology requires less land to establish and run therefore it can easily be taken up by land resource constrained women and youth. • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles
Gender related opportunities	• Youths and women groups will benefit from setting up and running macro propagation units through sale of planting materials. They will also have enough material for Banana orchard establishment and expansion.
VMG issues and concerns in development, dissemination adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development, dissemination and benefits of the technology as well as information regarding the technology • VMGs face the barrier of accessing source of clean propagating material of the required varieties due to inadequate resources such as land and credit
VMG related opportunities	• Increased production will lead to improved food nutrition and security in the household to the benefit of the VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	The technology has been successfully piloted in Meru and Kirinyaga The protocol is available and has been practiced in West AfricA (Nigeria) and East Africa (Uganda) In Burundi, over ten NGOs have adopted the concept of macro propagation and have reduced the gap between Farmers and access to affordable clean quality planting material.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	**Reference:** Macro propagation Manual by IITA (Abdou Tenkouano, et al) available
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors, KU

GAPS

- Evaluate use of different media on production of plantlets
- Evaluate performance of plantains
- Evaluate the performance of macro propagation units under different AEZs

2.1.5 TIMP name	**Paring and hot water treatment**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity of local planting materials, high incidence of pests and diseases of seedlings and high cost of clean Tissue Culture materials.
What is it? (TIMP description)	This a management practice of producing pest and disease free planting materials by paring and hot water treatment
Justification	Banana is an important crop in Kenya used for food and income generation. However there is inadequate clean planting and many farmers rely on locally sourced planting materials which are diseased and infested by pests. Additionally most small holder farmers are resource constrained ad cannot afford tissue culture planting material thus have to rely on locally sourced suckers and corms for planting. This technology is key in ensuring locally sourced planting materials are pest and disease free thereby promoting a healthy banana orchard.
Region promoted	Kisii, Nyamira, Homabay, Migori, Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, farmers' groups, youth groups
Approaches used in dissemination	Hands on demonstration, farmer field days, ASK shows and farmer learning tours.
Critical/essential factors for successful promotion	• training of trainers, training farmers • Demand for clean planting material
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on selection, paring and treatment of Banana suckers either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • KU and KALRO will provide the technology and training of trainers
C: Current situation and future scaling up	
Counties already promoted if any	Kisii, Nyamira, Homabay, Migori, Siaya, Busia
Counties where TIMP will be up-scaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Understanding and acceptance of the technology by the farmers - Sustainable availability of healthy mother plants - Demand for clean suckers

Suggestions for addressing the challenges	- Sensitize and create awareness e.g. using demonstrations - Create sustainable supply network - Collaboration with county government in extension
Lessons learned in upscaling if any	- This is a low cost technology that promotes clean locally sourced planting material. - Farmers should not be completely discouraged from using planting materials sourced locally instead promote options of cleaning such material
Social, environmental, policy and market conditions necessary	• Banana is socially acceptable 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.
Basic costs	Sh 20 per sucker
Estimated returns	Shs 50 per sucker
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Gender inequalities in regard to access and control over resources such as land and household finances • Perceptions in regard to banana as a snack food • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles
Gender issues and concerns in adoption and scaling up	• The technology is acceptable and easy to upscale by males, females and the youth as it utilizes locally available material
Gender related opportunities	• Since women and youth may not have the resources and information to access Tissue culture and macro propagated material this technology provides a solution to acquire clean planting material. • It offers opportunities in enhancing food security with the rural households through orchard establishment and expansion.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing information regarding this technology as they may not attend trainings and other dissemination platforms
VMG issues and concerns in adoption and scaling up	• VMGs may not have enough resources such as land and capital to utilize this technology effectively.
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	

Success stories	The technology has been successfully piloted in Busia, Siaya, Kisii and Nyamira Counties. The protocol is available and has been practiced in West and East Africa.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1.Ready for upscaling
Application guidelines for users	Banana production technical guide
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors, KU

GAPS

- Evaluate effectiveness in eliminating pests and pathogens

2.1.6 TIMP name	**Drought tolerant banana varieties** (Williams and Chinese Cavendish)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity due to erratic rainfall occasioned by climate change
What is it? (TIMP description)	These are high yielding banana varieties with relative drought tolerance (Williams and Chinese Cavendish) that can perform well under unreliable rainfall. Its characteristic features include resistance to Fusarium race 1 and 2 and market preferred.
Justification	Banana is an important crop in Kenya used for food and income generation. Due to climate change most parts of the country experience erratic rains that are poorly distributed. This results in poor performance of banana crops that are mainly rain-fed. Most farmers plant local varieties that are susceptible to drought resulting in low yields. The tolerant varieties are able to withstand dry periods and still produce optimally. This makes them a viable option in adapting to climate change.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmer producer groups Nursery operators, farmer's groups, youth groups
Approaches used in dissemination	Hands on demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favorable weather. Willingness of communities or farmer groups to provide resources for demonstration.
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on the technology either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of these varieties and multiplication of the same. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be up scaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination and adoption	- Inadequate training materials on drought tolerant varieties. - Inadequate information on where to source for these varieties - Inadequate/unavailability of drought tolerant banana planting materials - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of drought tolerant banana planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology

Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs;

	• Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Farmers in eastern region-Meru, Embu, Tharaka have extensively grown these varieties successfully
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Validate and evaluate drought tolerance under different agro ecological zones.

2.1.7 TIMP name	Black *sigatoka* tolerant bananas **(FHIA 23, FHIA 01—Gold finger)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity due to high incidence of Sigatoka disease
What is it? (TIMP description)	These are high yielding varieties tolerant to Black Sigatoka disease that can perform well in Sigatoka hotspots
Justification	Banana is an important crop in Kenya used for food and income generation. Black Sigatoka is a common disease in banana growing areas in Kenya where it is known to cause losses of up to 50%. Climate change has influenced the risk and spread of the disease in tropical areas leading to poor performance of banana crops. Management and control of Black sigatoka and improve production of bananas in areas affected by the disease
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Bomet, Kericho, Nyeri, Tharaka Nithi and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups

Approaches used in dissemination	Hands on demonstration, plant clinics, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	training of trainers, favourable weather and provision of supplementary irrigation
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of Sigatoka tolerant varieties - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of Sigatoka tolerant banana planting materials - Collaboration with county government in supply of planting materials
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology

Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs

VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Available in KALRO centres and some farmers
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Study disease distribution and diversity of pathogen strains in Kenya
- Modelling studies to establish effect of climate change on disease incidence and distribution

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2.1.8 TIMP name	**Medium height banana varieties tolerant to wind damage and high market value** (Williams and Chinese Cavendish)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low productivity • High incidence of breakage due to wind • Lack and high cost of propping material
What is it? (TIMP description)	Medium height banana varieties tolerant to wind damage with a high market value **(Gros-Michel and Pelipita dessert)**
Justification	Banana is an important crop in Kenya used for food and income generation. Strong wind is major challenge limiting production of tall varieties. This results in the need for propping, which is labour

	intensive and also costly in terms of the poles. Adoption of wind tolerant varieties would eliminate crop loss due to wind damage thereby improving productivity and returns.
Region promoted	Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups, Nursery operators
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyangorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of medium height varieties - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of medium height banana planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain

Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity. • Enabling policy environment e.g. big 4 agenda
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• The technology may not benefit women and youth since they have limited access to land for banana cultivation than men. • Women and youth may also have limited access to finances for purchasing the technology (clean planting materials) • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant
Gender issues and concerns in adoption and scaling up	• Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands. Therefore for increased uptake the technology should target the household as a unit instead of individual partners.
Gender related opportunities	The technology is acceptable and easy to upscale by males, females and the youth. This will lead to building climate resilience among women and youth who are at a risk from climate change related issues.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs

VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	These varieties have been grown in Meru, Embu, Muranga, Kirinyaga where farmers have realized reduced losses from wind damaged Bananas.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Evaluate additional germplasm suitable for wind prone areas.

2.1.9 TIMP name	Dessert banana varieties tolerant to Panama disease **(Prata, Manyatta, Soth, Exera, Kifutu, Mysore and GT Kisii apple banana, Cavendish)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• High incidence of Panama disease • Yield losses and its economic impact caused by panama disease

What is it? (TIMP description)	Introduction of relatively Panama tolerant banana varieties **Prata, Manyatta, Soth, Exera, Kifutu, Mysore and GT Kisii apple banana, Cavendish** that can perform well in Panama hotspots for improved production.
Justification	Banana is an important crop in Kenya used for food and income generation. Panama is a common disease in banana growing areas in Kenya. Climate change has influenced the occurrence of the disease leading to poor performance of banana crops and significant yield losses. The disease cannot be controlled by fungicides therefore growing tolerant varieties is the most viable solution.
Region promoted	Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	Hands on demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favorable weather
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyangorora processors – will provide market for ready banana
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of panama tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri

Challenges in dissemination	- Inadequate/unavailability of Panama tolerant varieties - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of Panama tolerant banana planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands

Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	- Farmers in parts of Kisii and western Kenya had experienced losses resulting from panama disease which had affected the popular and susceptible 'sukari ndizi' apple banana variety. However the introduction of tolerantt apple banana varieties such as Gerald Tucker (Kisii sweet banana) has improved production of apple varieties.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Studies on Panama disease incidence, distribution, and strain diversity (emphasis on race 4).
- Modelling studies on relationship between climate change and disease occurrence and distribution in Kenya.

2.1.10 TIMP name	High yielding market preferred cooking banana varieties **(Ngombe, Sialamuli, Nusu-Ngombe and Uganda Green)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Inadequate supply of preferred cooking varieties • Low yields • Consumer preferred Taste
What is it? (TIMP description)	High yielding and good tasting cooking banana varieties **(Ngombe, Sialamuli, Nusu-Ngombe and Uganda Green)**
Justification	Banana is an important crop in Kenya used for food and income generation. The Demand for cooking variety is high for consumption and processing. About 60% of bananas grown in Kenya are the cooking varieties. However in many banana producing regions the varieties grown are low yielding, and lack market and consumer preferred characteristics such as taste, finger size and long shelf life. This affects production and market value leading to reduced income. The improved Varieties being promoted are high yielding, has a favorable taste and is market preferred.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Bomet, Kericho, Nyeri, Tharaka Nithii, Muranga, Kiambu and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups, Banana processors
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean planting materials of preferred cooking varieties • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training.

	• NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of high yielding cooking banana varieties and related technologies • Traders and processors such as -Nyangorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of high yield good tasting varieties - Inadequate funds to purchase planting material
Suggestions for addressing the challenges	- Provision of high yielding market preferred banana planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensure success of the project - Availing to farmers adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men.

	• Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	- These varieties are popular in all banana growing areas and market outlets
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762

Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Nutrient profiling of available varieties
- Evaluate performance of the high yielding good tasting varieties under different agro ecological zones
- Evaluate consumer preference in different major markets

2.1.12 TIMP name	**Banana variety Grand Naine**.
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High incidence of disease
What is it? (TIMP description)	A Cavendish banana variety (dessert type) – Early maturity, disease tolerant, high yielding, medium to long fingers, long shelf life, fruits remain firm after ripening, good taste hence high market demand.
Justification	Banana is an important crop in Kenya used for food and income generation. There is growing demand for dessert bananas with desirable traits especially in urban towns and hotels. Grand Nain variety is high yielding (bunch weight averages 30 kg), has long yellow fingers, and desirable flavor when ripe. These are market and consumer preferred characteristics which increases the market value of Grand Nain variety and subsequent income for the farmer and actors along value chain.
Region promoted	Kisii, Nyamira, Migori, Kiambu, Tharaka Nithii, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production.

	• Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyangorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of grand Nain variety clean planting material - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Collaboration with county government and other players in the private sector in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	

Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

2.1.13 TIMP name	**Banana variety Giant Cavendish:**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High disease incidence
What is it? (TIMP description)	A Cavendish dessert banana variety. Early maturity, high yielding and tolerant to diseases (panama). **Features:** outer skin is partially green and turns yellow when it ripens; an export variety;
Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, diseases, unmet market demand for big bunches and late maturity are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials

	• Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyangorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of varieties with big bunches - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of planting material of medium height banana variety with big bunches - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Nyangorora banana processors started as a youth group assisted by KALRO, KIRDI and department of agriculture in Kisii and Nyamira Counties - They are involved in banana value addition, making products such as wine, crisps, flour, juice, jam and pastries. - Provides market for many farmers- buys banana bunches at (KES 15-20) per kg compared to middlemen who buy at 200-500/ bunch. - Employs more than 20 youths

F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

2.1.14 TIMP name	**Banana variety: Valery:**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High incidence of disease
What is it? (TIMP description)	A dessert banana variety – Early maturity, high yielding and tolerant to panama disease **Features:** Fingers are green and yellow when it ripens, big bunch and are sweet (good flavour). It needs support as fruit develops
Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, unmet market demand for good taste and big bunches are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand

Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Valery is tall and prone to wind damage - Inadequate/unavailability of planting materials. - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of propping and wind breaks to reduce wind damage - Provision of planting materials of high yielding, variety with big bunches - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology

Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs;

	• Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Very popular in Meru
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

2.1.15 TIMP name	**Banana variety FHIA 17:**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High incidence to diseases
What is it? (TIMP description)	A dual purpose dessert and cooking banana variety– Early maturity, high yielding and tolerant to diseases (BXW) and drought. **Features:** Fingers are green and yellow when it ripens, big bunch and are sweet, good for processing (wine, jam); big stout stem withstands wind A dessert banana variety – Early maturity, high yielding and tolerant to panama disease **Features:** Fingers are green and yellow when it ripens, big bunch and are sweet (good flavour). It needs support as fruit develops
Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, diseases, drought, unmet market demand for good taste are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya,

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO- will provide clean tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of planting materials - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of healthy affordable planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology

	- Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as landand credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs

VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	- Becoming popular in banana growing areas because of big bunches
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Evaluation for performance under different agro ecological zones
- Validate its dual purpose use and value addition opportunities

2.1.16 TIMP name	Banana variety FHIA 23: .
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High disease incidence
What is it? (TIMP description)	A dessert banana variety – tolerant to leaf diseases, e.g. sigatoka; has big stout stem which does not easily break, high yielding – can give 40-60 kg per bunch. Among the FHIA cultivars, the FHIA-23 has the shortest flowering-to-harvest period (96 days).

	Features: Medium height variety, many hands with big fingers per bunch. Its sweet and soft pulp makes it good for dessert, raw or processed**.**
Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, diseases, market demand and poor taste are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Bomet, Kericho, Nyeri, Tharaka Nithii, Muranga, Kiambu and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of planting materials - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of healthy affordable planting materials - Collaboration with county government in supply of planting materials

	- Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit

VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Gaining popularity because of big size
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

GAPS

- Evaluate performance under different agroecological conditions
- Identify opportunities for value addition

2.1.17 TIMP name	Banana variety: **Ngombe:**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High disease incidence
What is it? (TIMP description)	A cooking banana variety – high yielding maturity and tolerant to diseases, uniform growth, **Features:** Long fingers good for chips and crisps, develops appealing golden yellow color when deep fried, outer skin is partially green and turns yellow when it ripens; excellent for making flour

Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, market demand and poor taste are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO Kandara- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of planting materials - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of healthy affordable planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain

Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology
Social, environmental, policy and market conditions necessary	• Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as landand credit

VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	- Very popular in Kisii
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors
2.1.18 TIMP name	Banana variety: **Uganda Green**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High incidence of diseases
What is it? (TIMP description)	A cooking banana variety – Early maturity, high yielding and tolerant to diseases, e.g. Panama, Cigar end rot **Features:** The fruit is harvested green, carefully peeled and then cooked and often mashed or pounded into a meal.
Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, diseases, unmet market demand for good tasting cooking varieties are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Bungoma, Kakamega, Vihiga,Bomet, Kericho, Nyeri, Tharaka Nithii, Muranga, Kiambu and Siaya,
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favourable weather and provision of supplementary irrigation Market demand
Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Muranga, and Siaya. However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscalled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of planting materials - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of healthy affordable planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology

Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs;

	• Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	Popular in western, central and eastern Kenya
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

2.1.19 TIMP name	Banana variety: **Mbolokoma**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low yields • High incidence of diseases
What is it? (TIMP description)	A cooking banana variety – Early maturity, high yielding and has the biggest bunch among cooking varieties **Features:** Fingers are green Early maturity, high yielding and tolerant to diseases, e.g. Panama, Cigar end rot.
Justification	Banana is an important crop in Kenya used for food and income generation. Low yield, market demand and poor taste are some of the major challenges limiting production of bananas in Kenya.
Region promoted	Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmer producer groups
Approaches used in dissemination	On farm demonstration, farmer field days, farmer to farmer extension, ASK shows and farmer learning tours
Critical/essential factors for successful promotion	Timely availability of planting materials, training of trainers, favorable weather and provision of supplementary irrigation Market demand

Partners/stakeholders for scaling up their roles and stage of involvement	**Roles of partners** • County government and private Extension service providers will train farmers on banana production either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice in banana production. • Tissue culture laboratories / banana hardening nursery operators - JKUAT, Mimea, KALRO- will provide clean drought tolerant tissue culture planting materials • Community farmer groups will provide land for demonstration of banana production and enhance spread of knowledge through farmer to farmer training. • NGOs such as world vision, Africa Harvest may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems. • KALRO – will train trainers and provide technical backstopping on dissemination of drought tolerant banana varieties and related technologies • Traders and processors such as -Nyanngorora processors – will provide market for ready bananas
C: Current situation and future scaling up	
Counties already promoted if any	The technology has been adopted by farmers in banana growing areas in Kisii, Nyamira, Migori, Busia, Embu, Kakamega, Vihiga, Bungoma, Muranga, and Siaya However, the uptake is low due inadequate/unavailability of drought tolerant banana planting materials.
Counties where TIMP will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Inadequate/unavailability of planting materials - Erratic weather patterns due to climate change - Inadequate funds to purchase planting materials
Suggestions for addressing the challenges	- Provision of healthy affordable planting materials - Collaboration with county government in supply of planting materials - Capacity building of farmers and service providers in banana value chain
Lessons learned in up-scaling if any	- Working with partners with comparative advantage will ensures success of the project - Availing farmers with adaptable and market preferred banana varieties enhances technology uptake - Linking entrepreneurs to credit and market enhances adoption of banana technology - Availability of gross margin information enhances adoption of technology

Social, environmental, policy and market conditions necessary	Banana is socially acceptable 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 domestic and international markets for the commodity.
Basic costs	100,000-120,000 per acre for 18 months as the initial cost
Estimated returns	450,000-500,000 per acre per year for five years
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Women and youth may also have limited access to finances to buy the required inputs such as clean planting materials than men. • Banana is considered as a tree in most rural communities hence women and youth are not allowed to plant it • It is also considered as a snack or food for children and women
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Women may not have time and mobility to attend extension activities far from home or held at times when they have other roles • Women usually work in collaboration with their husbands for easy access to land allocations for growing bananas hence avoid seeking permission from their husbands
Gender related opportunities	• Youths and women can set up hardening nurseries, processing units and use ripening chambers for ripening bananas to add value and increase profits • This will lead to women and youth empowerment through increased production and income • May also lead to enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing clean planting materials of the varieties due to inadequate resources such as land and credit
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Thus the technology is not easily adoptable by the VMGs

VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
Success stories	- Popularly grown and consumed in Uganda and also western Kenya. Farmers state that they are food secure and continue to earn increased income from this variety because its bunch fetches high prices at the market
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	Banana production: Field technical guide 2015
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, Africa Harvest, World Vision, Private farm input Stockists /Agro-vets, Tissue culture laboratories and hardening nurseries, Traders and processors

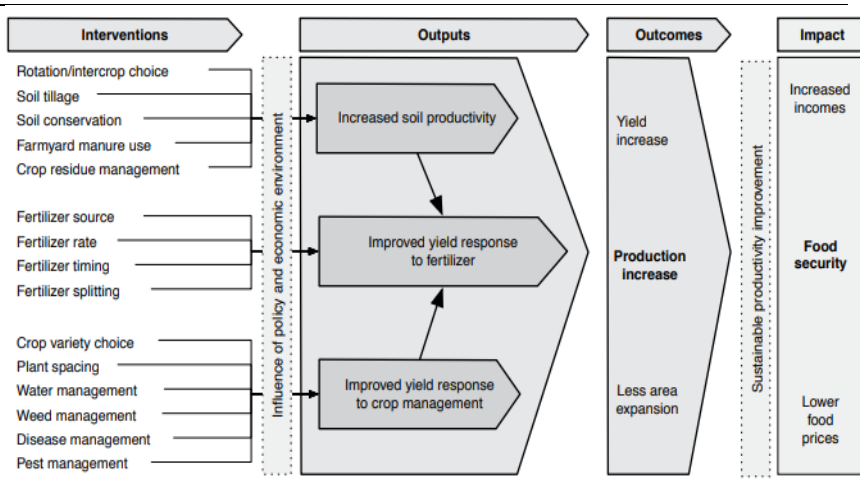
2.2 Agronomic practices

2.2.1 TIMP Name	**Integrated soil fertility management (ISFM) for bananas**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Declining soil fertility, low organic matter, soil acidification
What is it? (TIMP description)	A set of soil fertility management practices that include: Soil testing and analysis to determine nutrient levels in soil Integrated use of organic manure and inorganic fertilizers, - Timely application of fertilizer and manure - Intercropping with leguminous cover crops - Composting - soil erosion control measures and structures

	- Knowledge on how to adapt these practices to local conditions The aim is to optimize nutrient use and efficiency for improved banana productivity. All nutrient inputs need to be managed following sound agronomic and economic principles
Justification	The heterogeneity within the farming systems caused by spatial variability in soil fertility, which arises due to two main factors: Inherent differences that arise due to 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 project target counties are derived from some of the oldest land surfaces with few nutrients left. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of phosphorus Past management by farmers has a major influence on soil fertility Additionally lack of knowledge on nutrient requirement of bananas, time of application and amount of fertilizer and manure to apply has contributed to declining soil fertility in banana production and subsequent productivity. This call for an integrated soil fertility management that combines appropriate and sustainable interventions on soil management, fertilizer use and crop agronomy to drive increased productivity
Region promoted	Busia, Nyamira, Kisii, Migori, Embu, Meru and Muranga
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, NGOs
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	- Availability of affordable quality inorganic fertilizers - Availability of well decomposed farm yard manure or compost, - clean banana planting materials - Local adaptation potential of ISFM to take care of variability: • Within farms, in terms of farming goals, and objectives, farm size, labour availability, ownership of livestock, importance of off-farm income; and • Amount of production resources (i.e. land, money, labour, crop residues and animal manures) that different farming families are able to invest in the fields in their farm
Partners/stakeholders for scaling up, their roles and stage of involvement	**Role of each partner** County government and private Extension service providers will train farmers on ISFM either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice of ISFM in banana production.

	Community farmer groups will provide land for demonstration of ISFM and enhance spread of knowledge through farmer to farmer training. NGOs such as world vision and One Acre Fund may provide inputs to farmers such as clean planting materials and inorganic fertilizer for free or through affordable credit systems.
C: Current situation and future scaling up	
Counties where already promoted if any	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Meru, counties have been trained and are practicing some aspects of ISFM
Counties where TMPs will be up scaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in dissemination	- Lack of locally tested and adapted ISFM technologies that are site specific and value chain based - Lack of quality manure especially where small numbers of livestock are kept in a free range grazing system - High cost especially in areas where application of ISFM is non-responsive - Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	- Develop site specific and value chain based ISFM technologies - Clear misconceptions on fertilizer use through training - Encourage composting especially after harvesting period when plant material is available
Lessons learned in upscaling, if any	Low adoption is reported because of lack of site specific and value chain based ISFM technologies and the technicalities involved in implementation
Social, environmental, policy and market conditions necessary	- ISFM i**s** environmentally friendly and sustainable - Increased productivity will provide supply to the markets. Quality banana bunches as a result of using ISFM will attract better market - Enabling policy frameworks to support development and adoption of the TIMP in place
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done. Calculate the basic costs
Estimated returns	Not done Calculate the basic costs
Gender issues and concerns in development and dissemination	Gender responsive: the practice integrates participation of male and female roles during field implementation • Access to information may hinder women from fully utilizing aspects of ISFM • Women and the youth have unequal access to land and livestock than men. • Women and the youth have limited access to inputs such as improved fertilizer/ manure than men

Gender issues and concerns in adoption and scaling up	- Women's triple role may hinder them from attending training sessions - The technology may not be adopted if the gender targeted is overburdened especially women - Men own livestock and therefore the main decision makers on matters livestock especially how to collect and use manure from livestock - The practice is labour intense affecting adoption by various gender categories especially women.
Gender related opportunities	- If adopted by any gender especially men who own livestock/manure etc. it will lead to increased yields therefore enhanced food and nutritional security and income. - Youth can access information on ISFM, through ICT platforms therefore they can understand the long term benefits of ISFM in banana production - Women and youth groups can work collectively to manage the burden of labor when implementing ISFM
VMG issues and concerns in development and dissemination	- Due to their social status VMGs are often excluded from decision making in development and dissemination - VMGs face the barrier of accessing livestock manure and other inputs - VMGs may not be able to attend trainings and other knowledge sharing platforms on ISFM due to their social status or exclusion
VMG issues and concerns in adoption and scaling up	- ISFM is technically intense affecting adoption by VMGs - There is need to identify these groups in the community and redesign ISFM practices to suit their position such as labour saving approaches. - Adoption of the technology can be encouraged since there is little external cost involved. - In some cases VMGS may borrow manure from neighbors
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided The technology can provide food and nutrition security and a window for increased income
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. Additionally they've also realized increased banana yields form 15 -30 tons / ha and big quality bunches that attract a higher market demand and price leading to higher incomes.

Application guidelines for users	
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for upscaling
F: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

2.2.2 TIMP Name	**Mulching banana Orchards**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Accelerated loss of soil moisture-water stress in the soil, weeds, loss of organic matter leading to low yields, soil erosion from runoff water
What is it? (TIMP description)	Mulching is the practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop production. It means 'covering of soil' with natural mulches such as leaf, straw, dead leaves, stovers and compost and has been used for centuries
Justification	Soil moisture content is a major limiting factor in banana production especially in areas with erratic rainfall patterns. For optimal growth and production bananas require sufficient amounts of moisture. Mulching suppresses evaporation and hence prevents loss of soil water, which is

	important for growth. It also controls soil temperature fluctuation, reduces soil erosion from runoff water, improves infiltration rates suppresses weeds, improves physical, chemical and biological properties of soil. Ultimately this enhances growth and crop yield in bananas
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Busia, Meru and MurangaCounties have been trained and are practicing mulchingof their banana orchards
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, NGOs
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	1. Availability of plant or crop residues 2. Size of the land 3. Competing use of crop residues
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups, Water resource users associations, community forest associations. Mention roles of each partner County government and private Extension service providers will train farmers on mulching and conduct demonstrations either collectively or through farm to farm visits. Community farmer groups will identify sources of mulch material and also implement the technology on their farms Community forest association will offer advice on appropriate harvest of plant material from public forests that can be used as mulch
C: Current situation and future scaling up	
Counties already promoted	Nyamira, Migori, Siaya, Kakamega and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	- Inadequate plant and crop residues due to competing uses - Insect (pests, disease vectors) build up - Competing demand from livestock fodder i.e. maize and bean stover
Suggestions for addressing the challenges	- Establish integrated pest control management program for bananas - Crop diversification to increase availability of residues - Adapting alternative mulching materials like high absorbance polymers - Planting high biomass crops that can provide mulch material such as vertiver grass
Lessons learned	There is need to integrate mulching with use of organic materials like crop, plant residues, and agricultural processing wastes

Social, environmental, policy and market conditions necessary	• Mulching is socially acceptable and any technology to increase banana production while reducing cost of production will be readily adopted. • Mulching is an environmentally safe practice and can be practiced in any bio-physical environment. • Enabling policy frameworks to support development and adoption of the TIMP is in place • Awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take • Increased productivity will provide commodity for the market.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is low cost but labour intensive during the initial application (calculate)
Estimated returns	>100% of the initial investments (calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Initial Collection and application of Mulch may increase the workload for women. However eventually it will reduce the time spent for weeding which is mainly done by women. • Utilization of plant material from previous harvest such as maize stovers is mostly controlled by men which adds to the challenge of finding other sources of suitable mulch • Where mulch material has to be bought it will further constrain women and youth in taking up this technology
Gender issues and concerns in adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology reduces cost of production in the long run while saving on labor which will be relevant to women and youth for uptake and up scaling.
Gender related opportunities	• Target women and youth for training to improve performance. • Increased production and sales results in increased incomes for men, women and youth. this will lead to women and youth empowerment through increased production and income • Youth could also benefit through application of ICT networking for marketing and sourcing for information

	• An economical way of managing and utilizing agricultural waste such as banana peels and stalks for improved productivity
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the banana mulching TIMP due to inadequate production resources such as land and where to source for mulch material. • Reduction in cost of production from labor savings and increased banana production will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Access to quality mulch material and information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • The low cost nature of mulching and long term savings made from practicing the technology may increase the willingness of VMG to upscale the technology. • Willingness to use the technology • An economical way of managing and utilizing agricultural waste e.g banana peels for improved productivity
E: Case studies/profiles of success stories	
Success stories	Farmers have reported reduced cost of production per banana stool where mulch has been incorporated. The Bananas are also less affected by water stress during prolonged dry periods. As a result there is increased yields and income. Through application of crop residue (dried banana leaves /chopped pseudostems /stalks, maize and bean stover) increased banana yields from < 10 to more than 30 tons /ha. This gives and average income of Ksh.150,000-450,000 from 2 years.
Application guidelines for users	1. Shovel away old mulch, debris, and rocks to expose the tree trunk. A "mulch volcano" occurs when mulch is piled up year after year on the base of a tree. Mulch piled up at the base of a tree is detrimental and starves the roots of needed oxygen

	2. Prune growing roots growing upward (a sign of lack of oxygen)which can wrap around the base of the tree and kill it over time 3. Remove grass and other weeds with a spade or gardening claw. Scrape the area around the base of the tree to get rid of any weeds or grass 4. Spread a thin layer of mulch 4–5 feet (1.2–1.5 m) diameter around the tree. Leave (2.5–5.1 cm) of space between the base of the tree and the mulch 5. Pull any weeds or grass from the mulch or use herbicide around the plant 6. Rake the mulch occasionally to avoid compacting which can prevents oxygen from reaching the tree roots 7. Replenish the mulch around the tree once a year to keep off weeds, provide essential nutrients, and improve drainage
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Evaluate different mulching material in banana orchard

2.2.3 TIMP Name	**Intercropping bananas with legumes**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Need for crop diversification, land use efficiency declining soil fertility

What is it? (TIMP description) 	Intercropping is growing two or more crops on the same piece of land. The most common goal of intercropping is to maximize land use Intercropping Bananas with legumes is the simultaneous cultivation of Bananas with one or more legumes at the same time during the same season on the same piece of land. This system has been demonstrated to be more efficient than sole cropping in utilizing land, increasing production and improving the general ecology. The main goal of intercropping Bananas with legumes is to get improved productivity per unit land area and efficient utilization of land resources and farming inputs including labor.
Justification	Diminishing land sizes especially among smallholder farmers calls for the need to increase production per unit area. The recommended spacing in Bananas coupled with its perennial nature allows for intercropping with food or fodder legumes. This system ensures efficient land use utilization, improves soil fertility through Nitrogen fixation, and provides food through the short duration crops planted as intercrops. In addition legumes act as cover crops further improving soil conditions for increased banana productivity
Region promoted	Busia, Kisumu, Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Kericho.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, NGOs,
Counties where promoted, if any	Kisii, Nyamira, Bungoma
Counties where TIMP will be upscalled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	• Availability of leguminous seed varieties that are compatible with banana • Effective multiplication and distribution schemes for the improved planting materials of these varieties • Agronomic packages for intercropping to include time of planting, fertilizer rates, planting patterns

Partners/stakeholders for scaling up and their roles	• County government and private extension service providers will train farmers on intercropping system. They will also offer advice and collect information on the level of uptake and practice of intercropping • Agrovets and local stockists for provision of different legume seeds • NGOs such as world vision and One Acre Fund may provide inputs to farmers such as fertilizer and seeds for free or through affordable credit systems.
C: Current situation and future scaling up	
Counties already promoted if any	Kisii, Nyamira, Migori
Counties where TIMP will be upscalled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	- Limited access to clean seed of leguminous crops that are compatible with banana - Lack of effective multiplication and distribution seed schemes for the improved seed materials of these varieties Inadequate agronomic packages for intercropping
Suggestions for addressing the challenges	Develop effective legume seed systems More capacity building is required through on-station and on-farm demonstrations during farmer field schools and field days
Lessons learned	This is a management practice that is adopted widely and is useful in optimizing land productivity in a sustainable manner
Social, environmental, policy and market conditions necessary	- Intercropping bananas with legumes are environmentally friendly agricultural investments. - Intercropping is socially acceptable - Enabling policy frameworks to support development and adoption of the management practice is in place -
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is a low-cost management practice
Estimated returns	Increased productivity has been reported
Gender issues and concerns in development and dissemination	- Women and the youth may not have adequate land to implement the management practice because most of the land is owned and controlled by men. - Intercropping food legumes such as beans, cow pea, groundnuts and soya beans in Bananas will encourage

	women to take up the practice as it is beneficial to bananas and does not use up any extra land -
Gender issues and concerns in adoption and scaling up	- The technology is acceptable and easy to upscale by both males and females - The technology will utilize labor on weeding since as one weeds the legumes he will also be weeding the bananas simultaneously
Gender related opportunities	• If women or the youth adopt the technology yields are expected to increase leading to food and nutritional security in the households • More income for the adopters (men ,women and the youth) • Enhanced crop diversification that generate food and income on the short term before bananas reach maturity stage. • Enhanced product diversity of value chains hence increased resilience for men, women and the youth
VMG issues and concerns in development and dissemination	• VMGs have limited access to inputs and quality seeds due to their low status in society • Limited technical knowhow • The practice is low cost and enhances adoption for VMGs
VMG issues and concerns in adoption and scaling up	• Not recognizing VMGs as farmers, therefore services and information are not tailored to address their priorities • Adoption depends on different farmer goals and objectives. In addition to availability of the required inputs like clean planting materials and fertilizers
VMG related opportunities	• Production efficiency in banana legume intercrop system is viable to those with small parcels of land • Target VMGs when giving and when disseminating this TIMP • This will lead to Increased production and consumption of nutritious bananas for food while the food legumes will provide a rich source of proteins to ensure nutritional security
E: Case studies/profiles of success stories	
Success stories	Increased production per unit area from intercropping system has greatly benefited small holder farmers especially youths and women who are constrained by land. Other farmers have reported improved Soil conditions under this system, leading to increased banana yields

Application guidelines for users	**Row cropping:** involves the component crops arranged in alternate rows. Variations include alley cropping, where crops are grown in between rows of trees, and strip cropping, where multiple rows, or a strip, of one crop are alternated with multiple rows of another crop **Temporal intercropping**: uses the practice of sowing a fast-growing crop with a slow-growing crop, so that the fast-growing crop is harvested before the slow-growing crop starts to mature **Relay cropping**: where the second crop is sown during the growth, often near the onset of reproductive development or fruiting, of the first crop, so that the first crop is harvested to make room for the full development of the second **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 main 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 main crop in order to keep pests away from it.
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for upscaling
G: Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

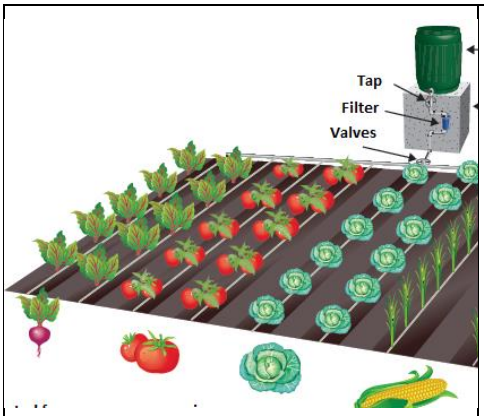
- Evaluate the performance under Zai pits in semi-arid agro ecological zone
- Evaluate the acceptability of the technology by the farmers in the project site

2.2.4 TMP **name**	***Zai* Pits to enhance banana production in ASALs**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Deficient and unreliable water to sustain a crop cycle as a result of high seasonal rainfall variability leading to total crop failures
What is it? (TIMP description) 	- *Zai Pits* are small planting pits typically measuring 60-90 cm in width, 60-80 cm deep and spaced 60-80 cm between them - The pits store water for crop use. Banana planting materials (TC and sucker) are planted into the pits after filling with two debes of organic material such as manure, compost, or dry plant biomass. The technology is suitable for areas with unpredictable rains especially the drought-prone areas in the ASALs
Justification	- Impacts of changing climate (low and erratic rainfall) is making agricultural activities very difficult in ASALs - *Zai Pits* technology harvests and stores water for crop use - Technology provide an effective way of improving the management of degraded lands and reducing soil erosion, vegetation loss and biodiversity as well as banana crop yield
Region promoted	Busia, Kisumu, Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Kericho.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, NGOs
Approaches used in dissemination	Demonstrations, farmer field schools (FFS), farmer learning tours
Critical/essential factors for successful promotion	Equipment for establishing Zai pits, timely availability of planting material
Partners/stakeholders for scaling up	Public/Private partners - County governments and NGOs (Kenya Red Cross (KRC), Action Aid, World Vision, and OXFAM). • County government and private extension service providers will train farmers on intercropping system. They will also offer advice and collect information on the level of uptake and practice of intercropping • Agrovets and local stockists for provision of different legume seeds • NGOs such as Kenya Red Cross (KRC), Action Aid, World Vision, and OXFAM may provide inputs to farmers such as fertilizer and seeds for free or through affordable credit systems.
C: Current situation and future scaling up	
Counties where already promoted if any	Practiced in most ASAL areas (Tana River, Garisa, Makueni) and have increased farmer's resilience to food and nutritional security
Counties where TIMPs will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi

Challenges in dissemination	The technology is Labour intensive and many farmers find it difficult to implement due to their poverty levels.
Recommendations for addressing the challenges	- Supporting farmers with equipment for preparing Zai pits - Intensive training on the technology
Lessons learned	Huge potential to increase farmers' resilience especially in ASALs
Social, environmental, policy and market conditions necessary	• *Zai Pits*are environmentally friendly agricultural investments • They conserve water and soil erosion and generally boost biodiversity • Enabling policy frameworks to support development and adoption of the *Zai Pits* are in place • The technology has Available markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Labour for Zai pit preparation is estimated at KES 80 to 100 per pit
Estimated returns	450 bunches after two years KES168,900
Gender issues and concerns in development and dissemination	• Zai pits requires capital investment. This may limit women and youth from accessing the technology due to lack of finances. • Zai pits are labour intensive and may add Women's workload. However, the benefits of food and nutritional security out ways issues of increased labour
Gender issues and concerns in adoption and scaling up	• Women's triple role may hinder them from attending training sessions • The technology may not be adopted if the targeted gender especially women are overburdened •
Gender related opportunities	- Good for the youth as they have energy to do the digging. - Leads to youth empowerment through increased production and income
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing Zai pits due to inadequate of resources
VMG issues and concerns in adoption and scaling up	• Zai pits technologies are not easily adoptable by the VMGs due to their low social status
VMG related opportunities	• Can be employed during digging

	• The youth can be employed to provide labour for digging Zai pits • Affirmative action, capacity building and practical support to be provided • The technology can provide food and nutrition security and a window for increased income
E: Case studies/profiles of success stories	
Success stories	• Has been used successfully in Makueni, Kilifi, Tana River with reports of yield increase • One farmer in Kathonzweni, Makueni County has already dug 170 pits and targeted 500 pits for production of sorghum. The farmer expects to harvest an average of 40-50 bags (90 Kgs) from one acre. for crop production.
Application guidelines for users	Refer to Zai pit Manual Number;
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for upscaling
KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762Centre Director, KALRO Kisii

2.2.5 TIMP name	**Drip irrigation systems for Banana production**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Climate change leading to prolonged drought resulting to reduced Banana production. • Increased crop water stress caused by seasonal rainfall variability in rain fed production leading to low yield or crop failure
What is it? (TIMP description)	- It is a type of micro-irrigation system that allows optimal usage of limited water resource by controlled delivery of the water to the plant root zone at low pressure using drip lines and emitters to minimise water loss. - The layout is above surface and is easy to design and operate. • It can be used to apply fertilise efficiently through fertigation It Provides the opportunity for farmers to increase crop yields

 Drip irrigation system	
Justification	• Kenya is generally a water-deficient country yet almost all crop production is rain fed. The impacts of climate change (seasonal rainfall variability and drought) to crop production is a real threat to food security. The drip irrigation offers an opportunity to produce food with limited water. Mainstreaming drip irrigation systems into crop production therefore provides the opportunity for farmers to enhance crop resilience, increase yields and incomes. Increased water saving means more water are available for other competing needs (domestic, livestock or industrial
Region promoted	Busia, Kisumu, Baringo, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Kericho.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers Hardening nursery operators Researchers
Approaches used in dissemination	Field demonstration, farmer field schools, ASK trade and exhibition fairs
Critical/essential factors for successful promotion	- Availability of clean quality water - Access to finances to procure the system - Awareness of the benefits of the systems - Correct field design (system installation) of the drip system to minimize water inefficiencies - Training of farmers and extension workers Drip system management skills
Partners/stakeholders for scaling up	• County Governments can sponsor purchase of irrigation kits for farmer groups or model farms • County government and private extension service providers will train trainers of trainers (TOTs and farmers on management of irrigation systems. • NGOs such as world vision, One Acre Fund, Kenya Red Cross, Action Aid, World Vision, OXFAM and Micro finance institutions (MFIs) may offer extension services, train trainers and credit facilities for purchase irrigation kits

	• AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua-Valley Services Ltd are suppliers of drip irrigation kits • Davis & Shirtliff are suppliers of water pumps, • NGOs (Kenya Red Cross, Action Aid, World Vision, OXFAM etc) – offer extension services and train trainers • KALRO - technical backstopping
C: Current situation and future scaling up	
Counties where promoted, if any	Used widely for high value horticultural vegetable crops such as tomatoes, capsicums in greenhouses and outdoor in Kiambu, Muranga, Meru, Kajiado, Marsabit Makueni
Counties where TIMP will be upscaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	• Relatively high cost of drip kits for majority of poor resource farmers in Kenya • High temperatures experienced in ASALs cause water salinity challenges • Drip poly tubing also tend to collapse causing inadequate water conveyance along the tube. • Limited awareness of the benefits of the TIMP • Water scarcity • lack of knowledge and skills in irrigation constrain management of the system
Suggestions for addressing the challenges	• Model farmer demonstration would create awareness and willingness to invest in the system • Modification of drip system tubes in ASAL areas is required (use of PVC pipes) to manage clogging and allow 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 • Awareness creation and farmer training is required on the management of drip irrigation system. • Build capacity on water harvesting, Storage and management of drip irrigation system • Regular maintenance of the system especially the drip filters is required to flush out accumulated salts that tend to clog emitters • Use PVC pipes ASALs to manage clogging
Lessons learned	- Drip system increases yield, incomes and food security. - Linking farmers to markets is critical for enhancing sustainability.

	- Soil mulching (crop residue or green manures) in a drip systems help preserve moisture and add nutrients to the soil - Linking farmers to financial institutions enables them to purchase systems - There are many successful farmers who have implemented drip irrigation system for up scaling -
Social, environmental, policy and market conditions necessary	- Drip systems are environmentally friendly agricultural investments. They are water-saving - Enabling policy frameworks to support development and adoption of the TIMP in place - Availability of markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	- Inputs materials include water source, drip lines, drippers, pumping unit, filtering and fertilizing systems ¼ acre costs between KSh. 50, 000 to 100,000
Estimated returns	Income from drip system rises by as much as 35% above that from conventional production systems
Gender issues and concerns in development and dissemination	- Women and youth face the barrier of accessing the irrigation systems due to lack of finances and the decision making system - Drip systems are easily installed and therefore are gender sensitive. - Drip systems tend to reduce women's workload and provide significant positive impacts on family food and nutritional intake. - Women are extensively involved in most horticultural farming enterprises (i.e. vegetable farming) under the drip-irrigation systems
Gender issues and concerns in adoption and scaling up	- Women's triple role may hinder them from attending training sessions - The technology may not be adopted by if the gender targeted is overburdened - The technology is acceptable and easy to upscale by both males and females
Gender related opportunities	• Women and youth empowerment through increased production and income • Enhanced product diversity of value chains hence increased resilience
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing irrigation systems due to inadequate of resources

VMG issues and concerns in adoption and scaling up	- Drip line technologies is not easily adoptable by the VMGs due to their social status
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • The technology can provide food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	- Drip technology has been successfully applied in many parts of the country over a considerable period of time. For example, James Mwenda from South Imenti, Meru County earns more than 130,000 per month from the sale of eggplants grown under Ithitwe Iraru irrigation project.
Application guidelines for users	• Refer to Drip irrigation technical handbook No. 24 "DRIP IRRIGATION: options for smallholder farmers in eastern and southern Africa • Use appropriate emitters during design and installation i.e. sites with elevation difference of over 1.5 m (5 ft) use pressure compensating emitters and flow emitters for more level areas; while for gravity flow systems use short-path emitters • Use 1 or 2 emitters per plant depending on the size of the plant; trees and large shrubs may need more • In most situations install emitters at least 450 mm (18″) apart. 600 mm (24″) apart under 80% of the leaf canopy of the plant • Always have a backflow preventer to prevent water contamination by soil-borne disease; use a 20 mm (3/4″) valve for most systems • Use 25mm (1 inch) PVC, PEX or polyethylene irrigation pipe for mainlines and laterals • The total length of the mainline and the lateral together should not be more than 120 meters (400 feet). • The length of drip tube should not exceed 60 m from the point the water enters the tube to the end of the tube • Never bury emitters underground unless they are designed that way • Do not bury drip tube to avoid damage by rodents • Always install a flush valve or end cap at the end of each drip tube or automatic flush valves
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	• validation
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road.

	P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua-Valley Services Ltd, Davis & Shirtliff, and Micro finance institutions (MFIs)

GAPS

- Water requirement for banana under different AEZs
- Evaluation of different irrigation systems

2.2.6 TIMP Name	**Use of green manure on banana orchards**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low orchard productivity Declining soil fertility
What is it? (TIMP description)	Use of nitrogen-fixing perennial or annual plants parts, in rotation or intercropped, either applied to surface or incorporated into the soil in between the banana plants
Justification	Soil fertility has been declining leading to low orchard productivity. Many small scale banana farmers lack resources to purchase chemical fertilizers thus green manure would be a good alternative
Region promoted	Farmers in Nyamira, Kisii, Kakamega, Vihiga, Siaya, and Muranga, Counties have been trained and are practicing green manuring on their banana orchards
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana farmers, agricultural colleges and universities
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	Availability of suitable green manure Availability of quality seed and other planting material
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups,. County government and private Extension service providers will train farmers on green maturing and conduct demonstrations either collectively or through farm to farm visits. Community farmer groups will determine suitable green manure and implement the technology on their farms
C: Current situation and future scaling up	

Counties already promoted	Nyamira, Vihiga, Kisumu, Siaya, Kakamega and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	High cost of seed and availability Erratic weather condition-drought Acceptance by farmers to incorporate green manure legume at the right time
Suggestions for addressing the challenges	Provide quality green manure seed Carry out cost benefit analysis
Lessons learned	There is need to integrate green manuring with use, plant residues, and agricultural processing wastes
Social, environmental, policy and market conditions necessary	• Green manure use is socially acceptable • Green manure is an environmentally safe practice and can be practiced in any bio-physical environment. • Enabling policy frameworks to support development and adoption of the TIMP is in place • Need to create awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take • Increased productivity will provide commodity for the market.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is low cost but labour intensive during the initial application (calculate)
Estimated returns	>100% of the initial investments (calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Green manuring may increase the workload for women. However eventually it will reduce the time spent for weeding which is mainly done by women.
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology reduces cost of production in the long run while saving on labor which will be relevant to women and youth for uptake and up scaling.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the banana mulching TIMP due to inadequate production resources such as land and where to source for mulch material. • Reduction in cost of production from labor savings and increased banana production will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies.

	• Lack of access information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas hence improved health of VMGs; • This is a cost effective and environmentally friendly way of maintaining soil fertility
E: Case studies/profiles of success stories	
Success stories	Farmers have reported reduced cost of production per banana with green manuring .There is increased yields and income.
Application guidelines for users	Determine the suitable green manure to use- Soya beans, Dolichos, Plant the crop between banana rows maintaining a distance of about a meter between the crop and bananas Incorporate the green manure into the soil
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	**Requires further research**
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPs

- Need to evaluate the suitable green manuring crops for banana
- Establish the best timing for incorporating the green manure into the soil
- Carry out cost/benefit analysis

2.2.7 TIMP Name	**ABCC Strategy for Banana Xanthomonas Wilt (BXW) management:**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Incidences of bacterial wilt disease in Western Kenya

What is it? (TIMP description)	This is a four-pronged strategy for BXW control and management, i.e. (that is, Avoid disease introduction, Break male buds, Cut down diseased plants, and Clean tools) for effective BXW control
Justification	Incidences of Bacterial wilt disease have been reported in Uganda and Western Kenya This is a very devastating disease with no cure thus the need to take the necessary protective and surveillance measures
Region promoted	Some farmers in Busia Siaya Kisumu Bungoma Counties have been trained
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, KEPHIS, HCD, Extension provider
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	Gross margin analysis Involvement of community and create awareness Continuous Surveillance Availability funds
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups,. County government and private Extension service providers will train farmers on the disease and conduct demonstrations either collectively or through farm to farm visits. Researcher to be involved in fine tuning control techniques
C: Current situation and future scaling up	
Counties already promoted	Nyamira, Migori, Siaya, Kakamega, Bungoma and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	High cost of labour for removing affected plants Not all community members will agree to remove affected plants Movement of affected materials(bananas) from an affected area to clean area thus spreading the disease
Suggestions for addressing the challenges	Sensitization on the disease and it effect Provide subsidy Limit movement of affected material
Lessons learned	Prevention is the best control measure Involvement of whole community in control is critical Collaboration between government and community
Social, environmental, policy and market conditions necessary	• The technology is an environmentally safe practice and can be practiced in any bio-physical environment. • Enabling policy frameworks to support development and adoption of the TIMP is in place • Awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	This is low cost but labour intensive (calculate)
Estimated returns	>100% of the initial investments (calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology increases the income per unit area which will be relevant to women and youth for uptake and up scaling.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the technology due to inadequate production resources such as land • Increased banana production and food security will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas and other crops hence improved health of VMGs; • This is a cost effective and environmentally friendly way of increasing food production and maintaining soil fertility
E: Case studies/profiles of success stories	
Success stories	The disease has been brought under control in Uganda. It has also been successfully controlled in Western Kenya especially in Busia Bungoma and Siaya Counties. Some successful farmers Josephine Owino and George Otieno- They are currently trainers of other farmers besides producing macro propagated bananas
Application guidelines for users	Avoid disease introduction, Break male buds, Cut down diseased plants, and Clean tools) for effective BXW control
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for up-scaling
G: Contacts	

Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Continuous surveillance to ensure no new outbreak
- Quarantine to check the spread

2.2.8 TIMP Name	**Organic + inorganic fertilizers:**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Low orchard returns • Declining soil fertility
What is it? (TIMP description)	This is the application of a combination of 20 kg of well decomposed farm yard manure **(dry)** plus 200 g of basal phosphate fertilizer (DAP, Mavuno planting, TSP)
Justification	Declining soil fertility Low orchard productivity
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Busia, Embu, Meru and Muranga, Kiambu Counties have been trained and are practicing green manuring on their banana orchards
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana farmers, extension officers, researchers
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	Availability of organic and inorganic fertilizers Gross margin analysis
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups,. County government and private Extension service providers will train farmers and conduct demonstrations either collectively or through farm to farm visits. Researchers will determine site specific optimal rate of fertilizers application
C: Current situation and future scaling up	

Counties already promoted	Nyamira, Migori, Siaya, Kakamega, Kiambu, Embu Muranga and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	High cost fertilizers Erratic weather condition-drought Myth/Misconception that chemical fertilizers destroy the soil and postharvest quality of bananas Unavailability of some fertilizers
Suggestions for addressing the challenges	Provision of subsidized inputs eg fertilizers Creating awareness Demonstrations
Lessons learned	There is need to integrate fertilizer's use with other technologies like conservation agriculture
Social, environmental, policy and market conditions necessary	• Commercial banana farmers are likely to adopt the technology than subsistence ones • Gross margin analysis should be available to enhance adoption. • There should be market demand for bananas for increased up take • Increased productivity will provide commodity for the market. • The technology will increase food and nutritional security
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of fertilizers
Estimated returns	>100% of the initial investments (calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Use of organic and inorganic fertilizers will increase orchard productivity thus enhance food and nutritionak security for the household
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology increases the income per unit area which will be relevant to women and youth for uptake and up scaling.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the technology due to inadequate production resources such as land • Increased banana production and food security will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies.

	• Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas and other crops hence improved health of VMGs;
E: Case studies/profiles of success stories	
Success stories	Farmers have reported increased return per unit area through use of organic and inorganic fertilizers
Application guidelines for users	• Carry out soil testing • Determine the appropriate combination and rate of organic and inorganic fertilizer to use • Apply accordingly ensuring appropriate timing mainly based on availability of rainfall • Determine whether the application is basal or topdressing for greater effectiveness
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	**Further research**
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO, Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Joseph Njuguna, Maina Mwangi, Willis Owino
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Determine the effect of inorganic fertilizers on soils and postharvest quality of bananas
- Determine the site specific rate of various fertilizers
- Determine the best combination of organic and inorganic fertilizers

2.2.9 TIMP Name	**Inorganic inputs (NPK):**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low orchard returns Declining soil fertility

What is it? (TIMP description)	Application of a combination of synthetically derived materials containing nitrogen (N), phosphorus (P), and/or potassium (K).
Justification	Declining soil fertility Low orchard productivity
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Busia, Meru and Muranga, Kiambu Counties have been trained and are practicing green manuring on their banana orchards
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers,
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	Availability of appropriate organic fertilizers Gross margin analysis
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups,. County government and private Extension service providers will train farmers on fertilizer use and conduct demonstrations either collectively or through farm to farm visits. Researchers will determine site specific optimal rate of inorganic fertilizers
C: Current situation and future scaling up	
Counties already promoted	Nyamira, Migori, Siaya, Kakamega, Kiambu, Embu Muranga and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	High cost fertilizers Erratic weather condition-drought Myth/Misconception that chemical fertilizers destroy the soil and postharvest quality of bananas Unavailability of some fertilizers
Suggestions for addressing the challenges	Provision of subsidized inputs eg fertilizers Creating awareness on benefits of fertilizer use Demonstrations on improved performance as a result of fertilizer use
Lessons learned	There is need to integrate fertilizer's use with other technologies like conservation agriculture
Social, environmental, policy and market conditions necessary	• Commercial banana farmers are likely to adopt the technology than subsistence ones • Gross margin analysis should be available to enhance adoption. • There should be market demand for bananas for increased up take • Increased productivity will provide commodity for the market.

	• The technology will increase food and nutritional security
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of fertilizers
Estimated returns	>100% of the initial investments (calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Use of inorganic fertilizers will increase orchard productivity thus enhance food and nutritional security for the household
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology increases the income per unit area which will be relevant to women and youth for uptake and up scaling.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the technology due to inadequate production resources such as land • Increased banana production and food security will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas and other crops hence improved health of VMGs;
E: Case studies/profiles of success stories	
Success stories	Farmers have reported increased return per unit area through use of inorganic fertilizers
Application guidelines for users	Carry out soil testing Determine the appropriate rate based on soil analysis Apply accordingly ensuring appropriate timing mainly based on availability of rainfall Carry out basal application for phosphoric fertilizes and topdressing for nitrogenous ones
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires	**Ready for upscaling**

validation; 3 requires further research	
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim and Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Determination of site specific rate of inorganic fertilizer required based on soil type
- Determine the appropriate fertilizers combination for optimal production
- Need to develop banana specific fertilizer

2.2.10 TIMP Name	**Integrated Pest and Disease Management (IPDM)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	High incidence of diseases and pests attack Low yield and quality of bananas
What is it? (TIMP description)	This is an integrated pest and disease management approach to improve banana productivity. It is a combination of cultural, biological and chemical methods. E.g pairing of suckers and hot water treatment of suckers to control weevils and nematodes, splitting of fresh pseudo stems to trap weevils, pruning and de-suckering to enhance air circulation, light penetration, and reduction of inoculum accumulation. ; cover crops for weed suppression; application of bionematone
Justification	Banana diseases and pest lower the yield and quality of bananas thus causing great losses in yield and income This is a very devastating disease with no cure thus the need to take the necessary protective measures
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Busia, Meru and Muranga, Kiambu Counties have been trained and are practicing green manuring on their banana orchards
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers,

Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	• Acceptance of the growers • Awareness of the technology and benefits • Provide gross margin analysis
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups,. County government and private Extension service providers will train farmers on the disease and conduct demonstrations either collectively or through farm to farm visits. Researchers to fine tune the technology
C: Current situation and future scaling up	
Counties already promoted	Nyamira, Migori, Siaya, Kakamega, Bungoma and Kisii., Meru,
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	Farmers appreciating IPDM as an effective strategy for pest control compared with conventional methods where chemicals are used
Suggestions for addressing the challenges	Sensitization on the diseases and pest and their effect on productivity and quality
Lessons learned	IPDM is suitable for small scale farmers because its cost effective
Social, environmental, policy and market conditions necessary	• The technology is an environmentally safe practice and can be practiced in any bio-physical environment. • Enabling policy frameworks to support development and adoption of the TIMP is in place • Awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(calculate)
Estimated returns	(calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Intercropping will increase the workload for women. However it will increase food security for the household
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology increases the income per unit area which will be relevant to women and youth for uptake and up scaling.

VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the technology due to inadequate production resources such as land • Increased banana production and food security will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas and other crops hence improved health of VMGs; • This is a cost effective and environmentally friendly way of increasing food production and maintaining soil fertility
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Banana IPDM guide
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim and Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Test biological products which can be used in control of nematodes and Fusarium under IPDM set up
- Determine the best IPM option for banana

2.2.11 TIMP Name	**Banana weevil control by pairing, hot water treatment and trapping**

Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Banana weevil infestation
What is it? (TIMP description)	**P**airing, and hot water treatment and trapping with pseudostem split to control weevil
Justification	Banana weevil is a major pest that can couse total destruction of the orchard. Beside reducing yield weevils cause toppling of banana plants thus increasing production loss
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Busia, Meru and Muranga, Kiambu **Counties**
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Agricultural colleges
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	Acceptance of the technology by farmers Provide gross margin analysis
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups,. County government and private Extension service providers will train farmers on the weevil and conduct demonstrations either collectively or through farm to farm visits. Researchers to fine tune the technology
C: Current situation and future scaling up	
Counties already promoted	Nyamira, Migori, Siaya, Kakamega, Bungoma and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	Low adoption of the technology since farmers are not able to relate low yield to weevil infestation Cost of heating water and knowing the suitable temperature Misconception that pairing will destroy the sucker
Suggestions for addressing the challenges	Sensitization on losses caused weevils Carry out cost benefit analysis
Lessons learned	Maintenance of field hygiene greatly reduce weevil infestation
Social, environmental, policy and market conditions necessary	• The technology is an environmentally safe practice and can be practiced in any bio-physical environment. • Enabling policy frameworks to support development and adoption of the TIMP is in place • Awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(calculate)

Estimated returns	(calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men • Intercropping will increase the workload for women. However it will increase food security for the household
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles • The technology increases the income per unit area which will be relevant to women and youth for uptake and up scaling.
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the technology due to inadequate production resources such as land • Increased banana production and food security will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas and other crops hence improved health of VMGs; • This is a cost effective and environmentally friendly way of increasing food production and maintaining soil fertility
E: Case studies/profiles of success stories	
Success stories	The technology has been used effectively by commercial banana producers
Application guidelines for users	• Sword sucker for planting is uprooted • Pairing is done (removal of all the roots) • The paired sucker is dipped in hot water at 55 ^{0}C before planting • Pseudostem is split longitudinally and then cut into small pieces(30 cm) • The small split are placed near the stool with the freh part facing downwards
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for up-scaling

G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim and Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- No of traps required per stool for effective control
- Frequency of changing the traps

2.2.12 TIMP Name	**Nematodes control by pairing, hot water treatment and biological products**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Nematode infestation
What is it? (TIMP description)	**Suckers , p**airing and hot water treatment to control nematode
Justification	Nematodes are major pests of banana and can cause total destruction of banana orchards leading to loss of nutritious food and income. Beside reducing yield they cause toppling of banana plants thus increasing production cost since propping becomes necessary
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Siaya, Busia, Meru and Muranga, Kiambu Counties have been trained and are applying the management practice in their orchards
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Banana growers, Farmers and agricultural colleges
Approaches used in dissemination	Farmer field business schools' demos, field days, farmer exchange tours, training workshops, published training manuals, ICT platforms
Critical/essential factors for successful promotion	Acceptance and application of the technology by end users Provide gross margin analysis
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups) County government and private Extension service providers will train farmers on the weevil and conduct demonstrations either collectively or through farm to farm visits. Researchers to fine-tune the technology
C: Current situation and future scaling up	

Counties already promoted	Nyamira, Migori, Siaya, Kakamega, Bungoma and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	• Low adoption of the technology since farmers are not able to relate low yield and loss of income to nematode infestation • Cost of heating water and knowing the suitable temperature • Labour intensive and misconception that pairing will destroy the sucker
Suggestions for addressing the challenges	Sensitization on the effect of nematodes on productivity and quality of bananas Carry out cost benefit analysis
Lessons learned	Maintenance of field hygiene greatly reduce nematode infestation and increases crop yield and income
Social, environmental, policy and market conditions necessary	• The technology is an environmentally safe practice and can be practiced in any bio-physical environment. • Enabling policy frameworks to support development and adoption of the TIMP is in place • Awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done yet, warrants a study
Estimated returns	
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men
Gender issues and concerns in adoption and scaling up	• Women's may not have time and mobility to attend extension activities far from home or held at times when they have other roles
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing the technology due to inadequate production resources such as land • Increased banana production and food security will favor VMG
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Affirmative action, capacity building and financial support to be provided • Increased production will lead to increased consumption of nutritious bananas and other crops hence improved health of VMGs;

	• This is a cost effective and environmentally friendly way of increasing food production and maintaining soil fertility
E: Case studies/profiles of success stories	
Success stories	The technology has been used effectively by commercial banana producers
Application guidelines for users	• Sword sucker for planting is uprooted • Pairing is done (removal of all the roots) • The paired sucker is dipped in hot water at 55 ^{0}C before planting • Pseudostem is split longitudinally and then cut into small pieces(30 cm) • The small split are placed near the stool with the freh part facing downwards
F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim, Martin Barare and Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Studies on combination of pairing, hot water treatment and bionematode

2.2.13 TIMP Name	**Banana APP**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Unavailability of extension Information on bananas
What is it? (TIMP description)	Internet based application which provides simplified extension information on banana value chain
Justification	Information flow to where is required is a major challenge. This has led to low adoption of technologies and subsequently low productivity
Region promoted	Some farmers in Nyamira, Kisii, Kakamega, Migori, Kisumu, Counties have been trained and are applying the management practice in their orchards
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Farmers and other value chain actors
Approaches used in dissemination	Digital online sharing
Critical/essential factors for successful promotion	Internet connectivity Smart mobile phone
Partners/stakeholders for scaling up and their roles	Public and private (County government extension services, community farmer groups, teaching institutions
C: Current situation and future scaling up	
Counties already promoted	Nyamira, Migori, Siaya, Kisumu, Kakamega, and Kisii.
Counties where TIMP will be up-scaled	Baringo, Kericho, Bomet, West Pokot, Nyeri and Tharaka Nithi
Challenges in dissemination	Lack of internet connectivity in some areas Information on how to download and use the application Lack of smart phone
Suggestions for addressing the challenges	Training on how to use the App Availing smart mobile phone in rural areas
Lessons learned	Farmers and extension officers are happy with it but more information is required on diseases and pests
Social, environmental, policy and market conditions necessary	• The innovation is an environmentally safe . • Enabling policy frameworks to support development and adoption of the TIMP is in place • Awareness of the benefits/advantages/management of the TIMP to enhance acceptability for increased up take
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	(calculate)
Estimated returns	(calculate)
Gender issues and concerns in development and dissemination	• Women and youth have limited access to land for banana cultivation than men
Gender issues and concerns in adoption and scaling up	• Women's may not have access to smart phone • There could be language barrier which would mainly affect women
VMG issues and concerns in development and dissemination	• Due to their social status VMGs are often excluded from access to innovations • VMGs may fail to access the innovation due cost or even bundles to download
VMG issues and concerns in adoption and scaling up	• Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. • Lack of access to information about the technology may hinder VMG from utilizing this technology.
VMG related opportunities	• Youth can use the APP for training
E: Case studies/profiles of success stories	
Success stories	The innovation has been used effectively by extension and KALRO staff in training service providers and farmers
Application guidelines for users	Go to KALRO website Download the APP

F: Status of TIMP readiness (1 Ready for up scaling; 2 requires validation; 3 requires further research	Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO Kisii: Off Kisii-Sotik Road. P.O Box 523-40200 Kisii email: kari.kisii@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: Nasambu Okoko, Catherine Muriithi, Julius Martim and Josiah Mogaka, Francis Wayua, Njuguna Kori, Maina Mwangi, Willis Owino , Lusike Wasilwa, A. Esilaba and J. Wamuongo,
Partner organizations	MoALF&C and County Governments, One acre fund, World Vision, Private farm input Stockists /Agro-vets.

GAPS

- Add more content especially on diseases and pest control

2.3 Harvest and Postharvest Management {BANANA}

2.3.1 TIMP Name	**Banana fruit protection bags/banana ripening bags/banana bunch covers**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Damage by insects, pathogens, wind damage, leaf and petiole scarring, dust, light, hail, sunburn, bird feeding, on banana bunches
What is it? (TIMP description) 	A translucent polythene bag cover is placed from the base of the bunch and tied at the top, right at the scar of the first bract There are two types of bagging: **traditional** (the cover is placed at the last horizontal hand stage, at which time the bracts have fallen) and **early bagging** (when no hand is yet visible). This last practice requires removing the fallen bracts that get stuck inside the cover. If they are not removed in time, the advantages of early bagging are not realized. Where thrips are a problem, early bagging is recommended. The cover is generally made of 0.08 mm thick polyethylene that is perforated every 76 mm. Each hole is 12.7mm in diameter. The cover is 90 cm in diameter and 155 cm long. Biodegradable covers have also been developed. The industry usually uses blue or transparent covers. Blue covers let in 73% of the wavelengths in the photosynthetically active

	radiation (PAR), whereas transparent ones let in 93%. Nevertheless, blue covers produce heavier bunches because it lets in heat without causing burns due to blockage of UV rays. Blue covers also do not harden the peel one of the disadvantages of bunch covers.
Justification	Bunch bagging creates a microclimate that leads to increased finger length and bunch weight due to optimum photosynthesis and improved postharvest quality, including appealing skin colour, reduced sunburn and reduced fruit splitting.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high-quality bananas, availability of quality standards
Partners/stakeholders for scaling up, their roles and stage of involvement	• County government and private extension service providers will train farmers on banana fruit protection bags/banana ripening bags/banana bunch covers either collectively or through farm to farm visits. They will also offer advice and collect information on the uptake and practice on the technology • KALRO – will train trainers and provide technical backstopping on dissemination of banana fruit protection bags. • Bioversity International – technical support on nutrition within banana agri-food systems; also engagement in workshops, training and M&E
C: Current situation and future scaling up	
Counties where already promoted, if any	Homa Bay, Nyeri, Meru, Kisii, Nyamira, Tharaka Nithi, Embu, Kirinyaga
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	• Banning of polyethene products in Kenya • Limited awareness of product by farmers • The use of non-perforated bunch covers in hot, humid climates may damage the bunch physiologically due to overheating, rotting, and premature ripening. • Insect pests may proliferate inside non-insecticide treated bunch covers. • Economic loss due to the extra cost of the material and labor needed for application
Suggestions for addressing the challenges	- Awareness creation about the product to the government agencies, farmers, and traders - Capacity building of farmers on how to use the products - Information dissemination – postharvest handling, value addition, and nutritional attributes of the product

	- Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling, if any	• Bunch bagging quickens maturity by two weeks, and improves the fruit quality. In central Kenya, a few farmers are adopting the method by improvisation, using the common yellow bags for shopping and synthetic fertilizer bags. • The paper can be impregnated with garlic and pepper solution to reduce thrips. • Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii visited Embu, Muranga and Meru from where they increasingly adopted the banana bunch bagging technology
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development and dissemination, adoption and scaling up	Target women and youth farmers/ entrepreneurs; start by targeting those entrepreneurs who are already involved in production of polythene bags or banana farmers.
Gender related opportunities	Women and youth stand to benefit in production and trade in bagging covers.
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop is considered a commercial crop and, therefore, its promotion and value addition will benefit all VMGs • High quality fruits will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	Opportunity to produce, trade in, and consume locally produced high quality bananas
E: Case studies/profiles of success stories	
Success stories	John Rukwaro, Nyeri County, has a five-acre banana farm in Nyeri. Rukwaro practices bagging technology, where he covers the tissue culture banana fruits to protect them from bacterial and fungi infections like Cigar end rot and Panama, a type of Fusarium wilt. His bananas produce bunches weighing up to 80kg, thanks to the bagging technology. He sells the bananas in Nyeri and Nairobi at between KES 300 to KES 500 depending on the size and weight. In a month, he is able to take in between KES 50,000 to KES 80,000. The bananas are ready for harvest from 12 to 14 months. The second harvest is done after every four months until the suckers die. (Source: *Seeds of Gold*, *Daily Nation* 10/12/2016)
Application guidelines for users	Banana bagging cover leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	

Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), Bioversity International, Farmer Groups, Service provider agencies e.g. financial institutions, traders and processors

GAPS

- Validation of the best polythene to use (i.e. colour and perforations) for bagging to give optimal results under different AEZs

2.3.2 TIMP Name	**Harvesting of bananas**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to inappropriate harvesting methods.
What is it? (TIMP description)  Fig. A. Banana harvesting	• This is a management practice involving careful maturing indices, pre-harvest operations and actual harvesting procedure. **Maturity indices** • TC bananas mature at 9-12 months while conventional suckers take 12-14 months. Some fruits turn yellow while others remain green at maturity. • The most common index of maturity is based on the fruit fingers of the banana. • The stage of maturity is judged by the angularity of the fingers: The more rounded a finger is in a cross-section, the more mature it is. The fingers are considered mature for harvesting when they are 3/4 round (75% maturity) **Harvesting** Recommended good practice for harvesting, include: • Placing a prop that can be made by two crisscrossing bamboo poles or forked angle branches and cutting below the prop, followed by removal of the prop to allow the trunk to fall gently to the ground, to avoid fruit damage. Padding materials comprising of gunny bags or dry banana leaves should be used on which the bunch is received.

 Fig. B. Banana harvesting	• Cutting one side of the trunk partially at an angle followed by a similar cut on the other side before pulling down the trunk (Fig. A). This is usually done by one individual. • Where two individuals are involved in harvesting, one can make a notch on the trunk a few feet below the bunch in order to allow the bunch to come down gently, while the second worker receives the bunch as it falls so that it does not touch the ground (Fig. B) After harvesting the bunch, the pseudo-stem is cut off with a clean implement at ground level. The cut is covered with soil to avoid easy entry by the banana weevil.
Justification	Inappropriate timing of harvesting and harvesting practices leads to rotting and postharvest losses of bananas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, aggregators, traders
Approaches used in dissemination	On-farm experimentation and demonstration, Farmer Field Schools, Innovation Platforms (IPs), leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• Farmers and farmer groups – Provide land for demonstration plots; labour; manage trials; keep records to be used in M&E • County government and private extension service providers will train farmers on appropriate harvesting procedures. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of appropriate harvesting procedure.
C: Current situation and future scaling up	
Counties where already promoted, if any	Kisii, Homa Bay, Migori, Makueni, Machakos
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	• Lack of knowledge and appropriate harvesting technology • Negative attitude by farmers towards adoption of new agricultural TIMPs
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of farmers on appropriate harvesting technology - Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling, if any	• Proper harvesting procedure reduce loss by up to 25%

	• Involvement of stakeholders such as CBOs and NGOs enhances adoption • Continuous capacity building is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	• In most cultures in Kenya, women are not allowed to harvest bananas (cutting of the pseudo-stem), hence they may not benefit from the technology. Men and male youth should be targeted in dissemination of the technology. • The TIMP is easily adoptable after training and many farmers can use the technology since it reduces losses incurred after harvesting.
Gender related opportunities	• The TIMP increases farm income through reduction of postharvest losses. Men and male youth can capitalize on this aspect of banana production to reduce postharvest losses.
VMG issues and concerns in development and dissemination, adoption and scaling up	• VMGs such as women and disabled cannot participate in harvesting of bananas due to cultural reasons and because harvesting requires physically fit persons (men and male youth) to cut the pseudo-steam and hold the bunch, which is heavy, protecting it from falling on the ground to avoid fruit damage.
VMG related opportunities	• Adoption of the TIMP means reduced postharvest losses, hence more fruit available for consumption and sale. • This will enable VMGs to have enough bananas to consume, hence get macro- and micronutrients (pro-vitamin A carotenoids) • There will bore more income for the farmers (VMGs)
E: Case studies/profiles of success stories	
Success stories	Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.
Application guidelines for users	Banana harvesting leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039

Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), Farmer Groups, Service provider agencies e.g. financial institutions, traders and private sector processors

GAP

- Establishing maturity indices for the specific varieties in different agroecological zone

2.3.3 TIMP Name	**Postharvest banana packaging**
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to inappropriate packaging methods.
What is it? (TIMP description)	This is a management practice involving proper banana postharvest packaging with banana leaves to reduce fruit damage, bruising and shrinking before reaching the consumer. The all-round leaves will cushion the fingers against bruises and breakages during movement. 
Justification	Lack of packaging or inappropriate packaging of bananas during transport from the farm to the market leads to losses due to fruit damage. The losses are of up to 30% or more before the fruit reaches the consumer, and are due to environmental agents (sunlight and strong wind) and breakages, cracking and bruising, more so when ferrying to far markets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, aggregators, traders, transporters
Approaches used in dissemination	Demonstration, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on appropriate postharvest packaging procedures. They will also offer advice and collect information on the uptake and practice on the technology

	• KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of appropriate postharvest packaging procedure.
C: Current situation and future scaling up	
Counties where already promoted, if any	Kisii
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	• Lack of knowledge and appropriate postharvest packaging technology, especially during transport to the market • Lack of knowledge and appreciation of the magnitude of postharvest losses in bananas • Negative attitude by farmers towards adoption of new agricultural TIMPs
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of farmers on appropriate harvesting technology, magnitude and economic significance of banana postharvest losses - Availing data on economics and the gains to be made through adoption of the TIMP
Lessons learned in up scaling, if any	• Proper postharvest packaging procedure reduce loss by up to 30% • Involvement of stakeholders such as CBOs and NGOs enhances adoption • Continuous capacity building of farmers and all value chain actors is key to attitude change. • Consistent trainings, demonstrations and sensitisations would motivate farmers to adopt the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	• Target women and youth as entrepreneurs in society who are the major adopters (traders and transporters) and consumers, respectively. • Develop a policy whereby superior quality bananas fetch higher prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	The technology is simple, acceptable and easy to upscale by males, females and the youth
Gender related opportunities	• The TIMP increases income for farmers and traders through reduction of postharvest losses.
VMG issues and concerns in development and dissemination, adoption and scaling up	The technology is simple, acceptable and easy to upscale by all VMGs
VMG related opportunities	• Adoption of the TIMP means reduces postharvest losses, hence more fruit available for consumption and sale.

	• This will enable VMGs to have enough bananas to consume, hence get macro- and micronutrients (pro-vitamin A carotenoids) • There will bore more income for the farmers (VMGs) and cheaper and nutritious bananas for consumers.
E: Case studies/profiles of success stories	
Success stories	Rigesa Youth Group in Nyamira County which supplies ripe, ripening, and plantain bananas to major town in Kenya such as Nairobi, Kisumu, Nakuru, Migori. The group uses the technology during transport of their bananas, and have realize six times earning of bananas.
Application guidelines for users	Postharvest banana packaging leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up-scaling
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), Farmer Groups, Service provider agencies e.g. financial institutions, traders and private sector processors

2.3.4 TIMP Name	**Zero Energy Brick Cooler (ZEBC)**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to lack of cooling facilities (postharvest cold chain)
What is it? (TIMP description) 	It is a low cost postharvest temperature management that improves the shelf life of banana using less power. Evaporative cooler works on the principle of cooling resulting from evaporation of water from the surface of porous materials such as sand or bricks. Hot dry air is drawn over the porous material. The water evaporates into the air using latent heat of evaporation, raising its humidity and at the same time reducing the temperature of the air within the chamber compared to the ambient temperature.
Justification	Lack of affordable and effective postharvest storage solutions often leads to spoilage, loss of income, and significant amounts of time spent traveling to sell and purchase fresh produce particularly in rural communities. While refrigerated cool stores are the best method of preserving fruits and vegetables they are

	expensive to buy and run in our local context. Consequently, simple low-cost alternatives, which do not require any external power supply or low-cost powered systems like Zero Energy Brick Cooler. The technology extends the keeping quality of bananas by at least 2 weeks, compared with control (ambient storage).
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, aggregators, traders
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on Zero Energy Brick Cooler. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of Zero Energy Brick Cooler.
C: Current situation and future scaling up	
Counties where already promoted, if any	Homa Bay, Migori, Makueni, Machakos
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	• Limited awareness of the technology by farmers • Water could be a challenge in some areas • Inadequate funds to construct the ZEBC
Suggestions for addressing the challenges	- Awareness creation about the product to the government agencies, farmers, and traders - Capacity building of farmers on how to use the ZEBC - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use - Recycling the water that runs down the sand
Lessons learned in up scaling, if any	• Linking entrepreneurs to credit and market enhances adoption of ZEBC technology • Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.
Social, environmental, policy and market conditions necessary for development and up-scaling	• Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. • Enabling policy environment encouraging use of clean energy in agriculture in areas with limited access to grid electricity

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Women may not have access to resources required for adoption of the enterprise.
Gender related opportunities	Women and youth stand to benefit in construction of the brick coolers (as *jua kali* artisans and masons)
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality fruits will lead to enhanced production and consumption by VMGs hence bettering their health and incomes. • However, VMGs face the barrier of accessing resources such as land and credit and may, therefore, not benefit from access to ZEBC.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality bananas. • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough bananas to consume, hence get macro- and micronutrients (provitamin A carotenoids) • The consumer will pay less for high quality bananas • The grower will also not be forced to make distress sale and will get better return.
E: Case studies/profiles of success stories	
Success stories	Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.
Application guidelines for users	Banana bagging cover leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), Farmer Groups, Service provider agencies e.g. financial institutions, traders and private sector processors

GAPS

- Validating the ZEBC under different AEZs
- Gross margins of the ZEBC

2.3.5 TIMP Name	**Coolbot™**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	High postharvest losses due to lack of cooling facilities (postharvest cold chain)
What is it? (TIMP description) 	It is a low cost postharvest temperature management that improved the shelf life of banana using less power The Coolbot™is a small electrical device that uses an off-the-shelf air conditioner to produce cold air, converting a well-insulated room into a cold room at much lesser cost than that needed to buy a refrigeration unit. It keeps a well-insulated room as cold as 4°C, consistently, while at the same time using about half the electricity of a comparably sized standard compressor.
Justification	Poor temperature management is one of the environmental factors that contribute to high postharvest losses in perishable commodities. This leads to spoilage, loss of income, and significant amounts of time spent traveling to sell and purchase fresh produce particularly in rural communities. The high cost of conventional cold rooms required for cold storage makes them inaccessible for majority of smallholder farmers in developing countries hence the need for cheaper alternatives. One such alternative is the Coolbot™ technology which has been tested and adopted in several countries.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, aggregators, traders
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• Farmers and farmer groups – Provide land for demonstration plots; labour; manage trials; keep records to be used in M&E • County government and private extension service providers will train farmers on Zero Energy Brick Cooler They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of CoolBot Cooler.
C: Current situation and future scaling up	
Counties where already promoted, if any	Homa Bay, Migori, Makueni, Machakos

Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	• Limited awareness of the technology by farmers • Inadequate funds to install the Coolbot™
Suggestions for addressing the challenges	- Awareness creation about the technology to farmers and traders - Capacity building of farmers on how to use the technology - Linkage to credit facility providers to promote commercialization, advocacy for its widespread use
Lessons learned in up scaling, if any	• Linking entrepreneurs to credit and market enhances adoption of Coolbot™ technology • Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 40,000/-
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Women may not have access to resources required for adoption of the enterprise.
Gender related opportunities	Women and youth stand to benefit in installation of the Coolbot™
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • High quality fruits will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced high quality bananas. • Nutritionally, use of the technology can reduce postharvest losses and enable VMGs have enough bananas to consume, hence get macro- and micronutrients (provitamin A carotenoids) • The consumer will pay less for high quality bananas • The grower will also not be forced to make distress sale and will get better return.
E: Case studies/profiles of success stories	
Success stories	Karurumo Smallholder Horticulture Aggregation and Processing Centre, in Embu County. Use of the technology has enabled the Centre to sell their mango fruits to different buyers for between KES 6 and 10 a piece, up from the KES 3 to 5 offered by most buyers during the peak season.
Application guidelines for users	Cool bot leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires	Requires validation

validation; 3. Requires further research)	
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), Farmer Groups, Service provider agencies e.g. financial institutions, traders and private sector processors

GAPS

- Validating the Coolbot™ for banana storage under different AEZs
- Gross margins of the Coolbot™

2.4 Value addition of banana

2.4.1 TIMP Name	**Banana flour**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Limited utilization of banana (emphasise nutrition component) • Over dependence on maize as the main source of flour.
What is it? (TIMP description)	Flour prepared from dried banana (cooking varieties)
Justification	Over dependence of maize flour. Maize production has been negatively affected by climate change – e.g. Maize Lethal Necrosis Disease (MLND) and Fall Army Worm (FAW). Hence the need to diversify flour sources. Use of banana flour is one such example. Diversification of banana food products will enhance consumption of banana, and demand thus spur increased production. Bananas can be processed to make flour, which can either be fortified or used to make nutritious porridge, or mixed with wheat flour (ration of 1:1) to make various bakery products (*chapati, mandazi*, bread and cakes). Use of banana flour will reduce over-reliance on maize flour for human nutrition in Kenya.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, aggregators, traders

Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); increased production of high-quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• Farmer groups – provide land for establishment of small-scale banana flour processing facility • County government and private extension service providers will train farmers on banana flour production technology. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of banana flour production technology. • KEBS – Standards formulation for banana flour; certification of private banana flour processors • Private sector processors (e.g. Nyangorora Banana Processors, KEBUK Banana Processors) – will be used as ToTs to train farmers on banana flour production; they will also act as market for the banana flour from farmers • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the banana flour
C: Current situation and future scaling up	
Counties where already promoted, if any	Homa Bay, Migori, Makueni, Machakos Meru, Kisii, Nyamira, Tharaka Nithi, Kakamega, Murang'a, Nyeri, Embu, Kirinyaga, Bungoma
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	• Limited awareness of the technology by farmers • Majority of the Kenyan population only recognizing maize as the staple food • Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities
Suggestions for addressing the challenges	- Awareness creation about the product to the government agencies, farmers, and traders - Capacity building of farmers on how to use the products - Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for its widespread use - Nutrition education to Kenyan consumers on the need to diversify their food base and include other crops like bananas. - Working with KEBS to develop standards for banana flour - Linking farmers to credit facility providers to get capital to engage in banana flour production agribusiness.
Lessons learned in up scaling, if any	• Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii

	visited KIRDI and learned on the banana flour production technology. • Adequate capacity building is essential for technology adoption.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 120/- per kg of banana flour
Estimated returns	KES 200/- per kg of banana flour
Gender issues and concerns in development, dissemination, adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside sellers of *mandazi* and *chapatti* in the study areas, who may find it easy to incorporate banana flour into their product portfolios.
Gender related opportunities	Women and youth stand to benefit in production, use and sale of banana flour. Start by targeting informal roadside sellers of *mandazi* and *chapatti* in the study areas, who may find it easy to incorporate banana flour into their product portfolios.
VMG issues and concerns in development and dissemination, adoption and scaling up	• Banana flour can be used to make cheap nutritious food products, which will lead to enhanced production and consumption by VMGs hence bettering their health and incomes. • The micro-nutrients in banana flour are particularly healthy for persons with HIV/AIDS
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced banana flour based products • Nutritious products can be made from banana flour contributing to the nutrition of VMGs. • Women can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	• The Kisii Banana Processing Factory • The case of Nyangorora Banana Processors in Kisii County • Afmago Self Help Group in Kisii • Khwisero Emuhaya, Butere and Kakamega (KEBUK) banana mini-processing factory in Khwisero town. • These groups process banana flour and sell to the community; they also use the flour to make baked products (bread, *mandazi*, cakes and buns.) • The case of G-Star Youth group in Nyeri. The group buys bananas from the local community which they dry using solar driers, mill and then pack the flour. They mill banana porridge flour fortified with maize and sorghum, which they sell locally. • The case of Monica Kithinji, a 73-year old banana farmer from Nkubu, Meru County, who makes KES 400,000 profit monthly from selling the nutrient-rich flour. She owns Wedo Foods, a banana flour processing company. She supplies banana flour to Kirinyaga Millers and Stawi Foods and Fruits Ltd.

Application guidelines for users	Banana flour production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), KEBS, Farmer Groups, Service providers e.g. financial institutions, traders and processors

GAPS

- Optimizing blending *ratio* and processing *procedures* for banana flour.
- Characterising the various banana varieties for their banana flour yield production potential
- Providing data on gross margins for banana flour production

2.4.2 TIMP Name	**Fried banana chips**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Limited banana utilization products. • Limited utilization of banana (emphasise nutrition component)
What is it? (TIMP description)	A food product prepared by deep frying banana (cooking variety) chips
Justification	Diversification of banana food products will enhance consumption of banana, enhance demand and thus spur increased production. Chips are mainly produced from irish potatoes, and production of chips from bananas will diversify the chips base available to consumers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, schools and training institutions, consumers
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships

	(PPP); availability of high quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on banana flour production technology. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of banana flour production technology. • KEBS – Standards formulation for banana flour; certification of private banana chips processors • Private sector processors (e.g. Nyangorora Banana Processors, KEBUK Banana Processors) – will be used as ToTs to train farmers on banana flour production; they will also act as market for the banana flour from farmers • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the banana chips
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Kirinyaga, Embu, Taita Taveta, Muranga, Kisii, Tharaka Nithi, Bungoma, Nyamira, Kakamega and Homa Bay.
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Cooking bananas mainly boiled; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added banana products
Suggestions for addressing the challenges	- Awareness creation about the product to farmers, consumers and other value chain actors. - Capacity building of farmers on how to prepare the product - Information dissemination – postharvest handling, value addition, and nutritional attributes of the product - Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialization, advocacy for standards development for value added banana products; nutrition education to consumers
Lessons learned in up scaling, if any	• Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii visited KIRDI and learned on the banana chips production technology. • Adequate capacity building is essential for technology adoption.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated

Gender issues and concerns in development, dissemination, adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting those entrepreneurs who are already involved in production of potato chips, who may find it easy to incorporate banana chips into their product portfolios.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination, adoption and scaling up	The technology can be adopted by all VMGs who can engage in production, sale and consumption of banana chips.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced banana flour based products • Nutritious products can be made from banana flour contributing to the nutrition of VMGs. • Women can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	• The case of Nyangorora Banana Processors in Kisii County, and • Khwisero Emuhaya, Butere and Kakamega (KEBUK) banana mini-processing factory in Khwisero town. • These two groups process the product and sell to the community and also to shops and supermarkets.
Application guidelines for users	Banana chips production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	MoA (County Governments), KEBS, KIRDI, Farmer Groups, Service provider agencies e.g. financial institutions, processors and manufacturers, private sector processors e.g. Nyangorora Banana Processors in Kisii and KEBUK Factory in Kakamega County, supermarkets, institutions (schools, hospitals)

GAPS

- Characterising the various banana varieties for their banana chips production potential (for example, which variety produces the best quality chips?)
- Optimising the chips production procedures
- Providing data on gross margins for fried banana chips production

2.4.3 TIMP Name	**Fried banana crisps**
Category (i.e. technology, innovation or management practice)	Technology

A: Description of the technology, innovation or management practice	
Problem to be addressed	• Limited value addition and utilization of banana products.
What is it? (TIMP description)	A food product prepared from baked or deep fried banana chips (from cooking bananas)
Justification	Diversification of banana food products will enhance consumption of banana, enhance demand and thus spur increased production. Chips are mainly produced from irish potatoes, and production of chips from bananas will diversify the chips base available to consumers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality bananas, availability of quality standards
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on banana flour production technology. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of banana flour production technology. • KEBS – Standards formulation for banana flour; certification of private banana chips processors • Private sector processors (e.g. Nyangorora Banana Processors, KEBUK Banana Processors) – will be used as ToTs to train farmers on banana flour production; they will also act as market for the banana flour from farmers • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the banana chips
C: Current situation and future scaling up	
Counties where already promoted, if any	Kisii
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Cooking bananas mainly boiled; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added banana product; limited appropriate packaging materials
Suggestions for addressing the challenges	- Awareness creation about the product to farmers, consumers and other value chain actors. - Capacity building of farmers on how to prepare the product

	- Information dissemination – postharvest handling, value addition, and nutritional attributes of the product - Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialisation, advocacy for standards development for value added banana products; nutrition education to consumers - Development of environmentally friendly packaging materials
Lessons learned in up scaling, if any	• Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii visited KIRDI and learned on the banana crisps production technology. • Adequate capacity building is essential for technology adoption.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	A bunch of banana costs KES 450/-, add cooking oil, and packaging costs This produces xx sachets of crisps
Estimated returns	A 50g sachet of banana crisps costs KES 50/-
Gender issues and concerns in development, dissemination, adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting those entrepreneurs who are already involved in production of potato chips, who may find it easy to incorporate banana chips into their product portfolios. Target women and youth agro-processors / entrepreneurs; start by targeting those entrepreneurs who are already involved in production of potato chips, who may find it easy to incorporate banana chips into their product portfolios.
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	• Opportunity to produce, trade in, and consume locally produced banana flour based products • Nutritious products can be made from banana flour contributing to the nutrition of VMGs. • Women can diversify family diet and generate income at village level by making the products for sale
E: Case studies/profiles of success stories	
Success stories	• The case of Nyangorora Banana Processors in Kisii County, and • Khwisero Emuhaya, Butere and Kakamega (KEBUK) banana mini-processing factory in Khwisero town. • These two groups process the product and sell to the community and also to shops and supermarkets.

Application guidelines for users	Banana crisps production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	MoA (County Governments), KEBS, KIRDI, Farmer Groups, Service provider agencies e.g. financial institutions, processors and manufacturers, private sector processors e.g. Nyangorora Banana Processors in Kisii and KEBUK Factory in Kakamega County, supermarkets, institutions (schools, hospitals)

GAPS

- Characterising the various banana varieties for their banana crisps production potential (for example, which variety produces the best quality crisps?)
- Optimising the crisps production procedures
- Providing data on gross margins for fried banana crisps production

2.4.4 TIMP Name	**Banana juice**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Limited banana utilization products. • High postharvest wastage especially of ripe bananas
What is it? (TIMP description)	Juice prepared from ripe bananas
Justification	Diversification of banana food products will enhance consumption of banana, enhance demand and thus spur increased production. Over-ripe bananas should not be thrown away. The bananas which have a sweet taste, fine flavour and texture can be processed into juice for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality bananas, availability of quality standards; Farmers should organise themselves into growers' associations which facilitate setting up of factories to process bananas into

	various products; The government should facilitate affordable credit to empower farmers take up banana agribusiness.
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on banana juice production. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of banana juice production. • KEBS – Standards formulation for banana juice; certification of private banana juice processors • Private sector processors (e.g. Nyangorora Banana Processors, KEBUK Banana Processors) – will be used as ToTs to train farmers on banana juice production; they will also act as market for the banana flour from farmers • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the banana juice
C: Current situation and future scaling up	
Counties where already promoted, if any	Kisii, Meru
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Dessert bananas mainly ripe; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value-added banana products
Suggestions for addressing the challenges	- Awareness creation about the product to farmers, consumers and other value chain actors. - Capacity building of farmers on how to prepare the product - Information dissemination – postharvest handling, value addition, and nutritional attributes of the product - Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialisation, advocacy for standards development for value added banana products; nutrition education to consumers
Lessons learned in up scaling, if any	• Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii visited KIRDI and learned on the banana juice production technology. • Adequate capacity building is essential for technology adoption.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up banana agribusiness.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated

Gender issues and concerns in development, dissemination, adoption and scaling up	Target women and youth agro-processors / entrepreneurs; start by targeting informal roadside sellers of fresh fruit juices
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume banana juice
E: Case studies/profiles of success stories	
Success stories	• The case of Nyangorora Banana Processors in Kisii County • This group processes banana juice and sell to the community
Application guidelines for users	Banana juice production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), KEBS, KIRDI, Farmer Groups, Service provider agencies e.g. financial institutions, processors and manufacturers, private sector processors e.g. Nyangorora Banana Processors in Kisii and KEBUK Factory in Kakamega County, supermarkets, institutions (schools, hospitals)

GAPS

- Fine-tuning the production protocol and packaging
- Determining market demand and gross margins
- Characterize different banana varieties for their nutritional composition and suitability in processing various value-added products (flour, juice, jam, wine)

2.4.5 TIMP Name	**Banana jam**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Limited banana utilization products. • High postharvest wastage especially of ripe bananas
What is it? (TIMP description)	Jam prepared from ripe bananas

Justification	Diversification of banana food products will enhance consumption of banana, enhance demand and thus spur increased production. Over-ripe bananas should not be thrown away. The bananas which have a sweet taste, fine flavour and texture can be processed into jam from the kitchen for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality bananas, availability of quality standards; Farmers should organise themselves into growers' associations which facilitate setting up of factories to process bananas into various products; The government should facilitate affordable credit to empower farmers take up banana agribusiness.
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on banana wine production technology. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of banana jam production technology. • KEBS – Standards formulation for banana jam; certification of private banana jam processors • Private sector processors (e.g. Nyangorora Banana Processors, KEBUK Banana Processors) – will be used as ToTs to train farmers on banana jam production; they will also act as market for the banana from farmers • Supermarkets and institutions (e.g. schools and hospitals) will provide markets for the banana jam
C: Current situation and future scaling up	
Counties where already promoted, if any	Kisii, Meru
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Cooking bananas mainly boiled; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added banana products
Suggestions for addressing the challenges	- Awareness creation about the product to farmers, consumers and other value chain actors. - Capacity building of farmers on how to prepare the product

	- Information dissemination – postharvest handling, value addition, and nutritional attributes of the product - Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialisation, advocacy for standards development for value added banana products; nutrition education to consumers
Lessons learned in up scaling, if any	• Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii visited KIRDI and learned on the banana juice production technology. • Adequate capacity building is essential for technology adoption.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Target women and youth agro-processors / entrepreneurs
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	Opportunity for VMGs to produce, trade in, and consume banana juice
E: Case studies/profiles of success stories	
Success stories	• The case of Nyangorora Banana Processors in Kisii County, and Khwisero Emuhaya, Butere and Kakamega (KEBUK) banana mini-processing factory in Khwisero town. • These groups processes banana jam and sell to the community
Application guidelines for users	Banana jam production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	JKUAT, MoA (County Governments), KEBS, KIRDI, Farmer Groups, Service provider agencies e.g. financial institutions, processors and manufacturers, private sector processors e.g.

	Nyangorora Banana Processors in Kisii and KEBUK Factory in Kakamega County, supermarkets, institutions (schools, hospitals)

GAPS

- Characterising the various banana varieties for their banana jam production potential (for example, which variety produces the best jam?)
- Optimising the jam production procedures
- Providing data on gross margins and market demand for banana jam production

2.4.6 TIMP Name	**Banana wine**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Limited banana utilization products. • High postharvest wastage especially of ripe bananas
What is it? (TIMP description)	Wine prepared from ripe bananas. It is made by fermenting banana juice by adding wine yeast and sugar.
Justification	Diversification of banana food products will enhance consumption of banana, enhance demand and thus spur increased production. Over-ripe bananas should not be thrown away. The bananas which have a sweet taste, fine flavour and texture can be processed into wine from the kitchen for both domestic use and sale.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, small-scale processors, entrepreneurs, traders, restaurants, consumers
Approaches used in dissemination	On-farm experimentation and demonstration, field days, shows, exhibitions, Farmer Field Schools, Innovation Platforms (IPs), farmer exchange visits, leaflets; TV – "*Shamba Shape Up*"
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building and networks, promotions involving Public Private Partnerships (PPP); availability of high quality bananas, availability of quality standards; Farmers should organise themselves into growers' associations which facilitate setting up of factories to process bananas into various products; The government should facilitate affordable credit to empower farmers take up banana agribusiness.
Partners/stakeholders for scaling up and their respective roles	• County government and private extension service providers will train farmers on banana wine production technology. They will also offer advice and collect information on the uptake and practice on the technology • KALRO and JKUAT – will train trainers and provide technical backstopping on dissemination of banana wine production technology. • KEBS – Standards formulation for banana wine; licensing and certification of private banana wine processors • Private sector processors (e.g. Nyangorora Banana Processors, KEBUK Banana Processors) – will be used as ToTs to train farmers on banana wine production

	• Supermarkets and institutions will provide markets for the banana chips
C: Current situation and future scaling up	
Counties where already promoted, if any	Kisii County
Counties where TIMPs will be upscaled	Baringo, Bomet, Kericho, Tharaka-Nithi, West Pokot and Nyeri
Challenges in development and dissemination	Limited awareness of product by farmers and consumers; limited processing technology at the household level. Dessert bananas mainly eaten ripe; Difficulty in acquiring certificates from regulatory authorities, lack of standards for the product, lack of credit facilities, limited consumer awareness of value added banana products
Suggestions for addressing the challenges	- Awareness creation about the product to farmers, consumers and other value chain actors. - Capacity building of farmers on how to prepare the product - Information dissemination – postharvest handling, value addition, and nutritional attributes of the product - Involvement of regulatory agencies and policy makers in up-scaling process, linkage to credit facility providers to promote commercialisation, advocacy for standards development for value added banana products; nutrition education to consumers
Lessons learned in up scaling, if any	• Participation in farmer tours exposes farmers to new technologies and ideas. For example, the groups in Kisii visited KIRDI and learned on the banana juice production technology. • Adequate capacity building is essential for technology adoption.
Social, environmental, policy and market conditions necessary for development and up-scaling	Target women and youth as entrepreneurs in society who are the major adopters (manufacturers) and consumers, respectively. There is need for the government to facilitate affordable credit to empower farmers take up banana agribusiness.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not yet estimated
Estimated returns	Not yet estimated
Gender issues and concerns in development, dissemination, adoption and scaling up	Target women and youth agro-processors / entrepreneurs;
Gender related opportunities	Women and youth stand to benefit in production and trade in the product.
VMG issues and concerns in development and dissemination, adoption and scaling up	• The crop has high commercial potential and, therefore, its promotion and value addition will benefit all VMGs • Cheap nutritious food products made in their backyards will lead to enhanced production and consumption by VMGs hence bettering their health and incomes.
VMG related opportunities	Opportunity for all VMGs to produce, trade in, and consume locally produced high quality banana wine
E: Case studies/profiles of success stories	
Success stories	• The case of Nyangorora Banana Processors in Kisii County

	• This group processes banana juice and sell to the community
Application guidelines for users	Banana crisps production leaflets and manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO Kakamega P.O. Box 169-50100, Kakamega Email: kalro.kakamega@kalro.org or director.nrri@kalro.org Tel. 05620-30031/30039
Lead organization and scientists	KALRO; Francis Wayua, Nasambu Okoko, Willis Owino
Partner organizations	MoA (County Governments), KEBS, KIRDI, Farmer Groups, Service provider agencies e.g. financial institutions, processors and manufacturers, private sector processors e.g. Nyangorora Banana Processors in Kisii and KEBUK Factory in Kakamega County, supermarkets, institutions (schools, hospitals)

GAPS

- Characterising the various banana varieties for their banana wine production potential (for example, which variety produces the best wine)
- Optimising the wine production procedures
- Providing data on gross margins and market demand for banana wine production