INVENTORY OF CLIMATE SMART AGRICULTURE PIGEON PEA TECHNOLOGIES, INNOVATIONS & MANAGEMENT PRACTICES

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Under

KENYA CLIMATE SMART AGRICULTURE PROJECT (KCSAP)

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1.0 Definition of terms and summary tables of Finger MilletTechnologies, 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 Pigeon Pea Value Chain

The inventory process resulted in a total of 7 TIMPs including 5 technologies, 0 innovations, and 2 management practices, distributed among the 3 sub-themes, as indicated in Table 1

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Pigeon Pea	2.1 Improved varieties growth	5	0	0
Pigeon Pea	2.2 Good Agronomic practices (GAPs)	0	0	1
Pigeon Pea	2.3 Integrated Disease Management	0	0	1
Overall Total		**5**	**0**	**2**

1.3 Summary of Status of TIMPs in Pigeon Pea Value Chain

The inventory process resulted in a total of 7 TIMPs that are ready for upscaling, 0 TIMPs that require validation and 0 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
Pigeon Pea	2.1 Improved varieties growth	5	3	2
Pigeon Pea	2.2 Good Agronomic practices (GAPs)	1	1	0
Pigeon Pea	2.3 Integrated Pest and Disease Management	2	2	0
Overall Total		7		0

Table3: Inventory of Pigeon Pea TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1Improved varietiesgrowth		Technology	Ready for upscaling
	1.2 Pigeon Pea variety KARI Mbaazi 1	Technology	Ready for upscaling requires further research to improve on seed size
	1.3 Pigeon Peas Variety KAT 60/8	Technology	Ready for upscaling requires further research to improve on its small seed size
	2.1.1 Pigeon Pea KARI Mbaazi 2	Technology	Ready for upscaling Requires validation;
	2.1.2 Pigeon Pea Variety Mituki	Technology	Ready for upscaling Requires validation
	2.1.3 Pigeon Pea variety Kajani	Technology	Ready for upscaling Requires validation
2.2Good Agronomic practices (GAPs)	2.2.1 Good Agronomic practices	Management Practice	Ready for upscaling Requires validation
2.3Integrated Disease Management	2.3.1 Integrated Disease Management of Fusarium wilt	Management Practice	Ready for upscaling Requires validation
2.4Integrated Disease Management	2.4.1 Integrated Pest Management (pod borers, pod suckers)	Management Practice	Ready for upscaling requires further research

2.0 Detailed Pigeon Pea Value ChainTIMPS

2.1.1 Improved varieties

2..1.1 TIMP Name	KARI Mbaazi 1**.**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity, due to water scarcity, low yielding varieties and highly susceptible to pests
What is it? (TIMP description)	This is a short duration (Matures in 105-120 days) pigeon pea variety. It is short when grown at higher altitudes and tall at lower altitudes. The plant is compact and is normally grown as a sole crop. It flowers in 55-70 days and has medium seed size 10-12 g/100seeds. The yield potential is 1000 kg/ha or 4.4 bags/acre in one season and 2000 kg/ha or 8.9 bags/acre in two seasons and gives 2- 3 harvests in a year
Justification	ASALs are characterized by frequent drought leading to crop failure. Farmers' varieties are late maturing and give only one harvest per year. Pigeonpea is utilized as dry grain as well as green vegetable. Besides maturing early due to the short growing period, KARI Mbaazi 1 facilitates crop intensification and thus helps in improving productivity especially in low rainfall conditions. The variety can give three harvests per year as compared to local long duration lines used by farmers which give one harvest a year. Multiple harvests ensure continuous food security at the household level
B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Seed companies and Agro-dealers - Traders, Processors and Exporters - Other research organizations/institutions including universities
Approaches to be used in dissemination	- Farmer participatory evaluation - On-farm demonstration - Field days - Agricultural shows - Farmer to farmer - Media – TV "Mkulima programme" - Extension publications (posters/ brochures/leaflets) - NGOs
Critical/essential factors for successful promotion	- Seed availability, accessibility and affordability - Strong linkage among pigeonpea value chain actors – producers to market - Awareness campaign
Partners/stakeholders for scaling up and their roles	- KALRO to provide improved technologies

	- Extension service providers (public and private) to help in technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - ICRISAT - technology dissemination - NGOs technology dissemination through on-farm demonstrations - KILIMO trust - capacity building of farmers and linking farmers to markets and credit facilities - Seed companies - commercialization and marketing of the variety - Traders/exporters - marketing of the variety - Processors - Public institutions - schools (providing the market) - County governments - dissemination of the technology and linking farmers to external markets
C: Current situation and future scaling up	
Counties where already promoted, if any	Machakos, Nyeri and Tharaka Nithi.
Counties where TIMPs will be up scaled	Machakos
Challenges in development and dissemination	- Limited seed systems hinder farmers from obtaining seed for new varieties due to low demand for certified seed by farmers as farmers use own saved seed - High cost of certified seed - Limited access to rural finance for pulse production - Low dry grain yield for export as most of the production is consumed as green peas - Low use of inputs since farmers have always grown their traditional crop with no inputs even when available
Suggestions for addressing the challenges	- Capacity building on GAPs - Participation of stakeholders along the value chain in technology development and on-farm validation - Promote awareness among farmers on the disadvantages of recycling of seed - Promote use of inputs to increase yields
Lessons learned	- Partnership is important in technology dissemination and adoption - Involvement of end-user in technology development process helps in faster adoption of the technology
Social, environmental, policy and market conditions necessary for development and upscaling	- Socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done

Gender issues and concerns in development, dissemination, adoption and scaling up	- Pigeon pea is a women's crop from production to marketing. Increased yields will therefore provide increased income for women - As a short duration and high yielding variety it will meet the food and nutrition security of the whole household
Gender related opportunities	Green peas are highly marketable therefore both men, women and youth can trade in it
VMG issues and concerns in development, dissemination, adoption and scaling up	Most of the pigeon pea produced is consumed at the household level as green peas therefore it is important for improving the food and nutrition security for the whole household
VMG related opportunities	The technology can improve food and nutrition security and provides an opportunity for increased income
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide) in KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling 2. Requires validation 3. Requires further research to improve seed size
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, County government, Department of agriculture-Machakos, FAO

GAPs

Needs further research to improve the seed size of KARI Mbaazi 1
Need to work out the cost benefit analysis which is important for adoption and upscaling

2..1.1 TIMP Name	KAT 60/8
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to limiting moisture and low yielding varieties
What is it? (TIMP description)	This is a medium duration (Matures in 136-150 days) pigeon pea variety. It is short when grown at high altitudes and tall at lower altitudes. The plant is also compact and is normally grown as a sole crop. It flowers in 95-120 days and the grains are white in colour with brown spots and smaller than long duration local landraces (Tunyai). The yield potential ranges

	from 1200-1500 kg/ha or 5-7 bags/acre in one season and 3000 kg/ha or 13 bags/acre in two seasons. It has a spreading growth habit and flowering is indeterminate. This allows multiple harvests where soil moisture is adequate. It is susceptible to insect pests mainly pod sucking bugs and pod borers.
Justification	ASALs are characterized by frequent drought leading to crop failure. Pigeonpea is utilized as dry grain as well as green vegetable. Besides maturing early due to the short growing period, KAT 60/8 facilitates crop intensification and thus helps in improving productivity especially in low rainfall conditions. The variety can give two harvests per year as compared to local long duration lines used by farmers which give one harvest a year. Multiple harvests ensures continuous food security at the household level.
B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Seed companies and Agro-dealers - Traders, Processors and Exporters - Other research organizations institutions including universities
Approaches to be used in dissemination	- Farmer participatory evaluation - On-farm demonstration - Field days - Agricultural shows - Farmer to farmer - Media – TV "Mkulima programme" - Extension publications (posters/ brochures/leaflets) - NGOs
Critical/essential factors for successful promotion	- Seed availability, accessibility and affordability - Strong linkage among pigeonpea value chain actors from production to market - Strong partnership linkages - Awareness campaign
Partners/stakeholders for scaling up and their roles	- KALRO will provide seed for the variety - Extension service providers (public and private) to help in technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - ICRISAT - technology dissemination - NGOs - technology dissemination through on-farm demonstrations - KILIMO trust - capacity building of farmers and linking farmers to markets and credit facilities - Seed companies - commercialization and marketing of the variety - Traders/exporters - marketing of the variety - Public institutions - schools (providing the market) - County governments - dissemination of the technology and linking farmers to external markets

C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Kitui, and Tharaka Nithi.
Counties where TIMPs will be up scaled	Machakos
Challenges in development and dissemination	-Limited seed systems hinder farmers from obtaining seed for new varieties due to low demand for certified seed by farmers as farmers use own saved seed -High cost of certified seed -Limited access to rural finance for pulse production -Low dry grain for export as most of the production is consumed as green peas -Low use of inputs since farmers have always grown their traditional crop with no inputs even when available
Suggestions for addressing the challenges	- Capacity building on GAPs - Participation of stakeholders along the value chain in technology development and on-farm validation - Promote awareness among farmers on the disadvantages of recycling of seed - Promote use of inputs to increase yields
Lessons learned	- Partnership is important in technology dissemination and adoption - Involvement of end-user in technology development process helps in faster adoption of the technology
Social, environmental, policy and market conditions necessary for development and upscaling	- Socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 30,000
Estimated returns	Ksh 67,000
Gender issues and concerns in development and dissemination	Pigeonpea is a women's crop from production to marketing. Increased yields will therefore provide increased income for the women
Gender issues and concerns in adoption and scaling up	As a short duration and high yielding variety it will meet the food and nutrition security of the whole household
Gender related opportunities	Green peas are highly marketable therefore both men, women and youth can trade in it
VMG issues and concerns in development and dissemination	Most of the pigeonpea produce is consumed at the household level as green peas therefore it is important for improving the food and nutrition security
VMG issues and concerns in adoption and scaling up	The TIMPs are meant to increase the productivity therefore both gender can benefit from the increased production
VMG related opportunities	The technology can improve food and nutrition security and an opportunity for increased income
E: Case studies/profiles of success stories	
Success stories	

Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide) in KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, County government-Depart of agriculture, FAO

GAPs:

Needs further research to improve the seed size of KAT 60/8

2..1.1 TIMP Name	KARI Mbaazi 2**.**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to limiting moisture and lack of variety with farmer and acceptable traits
What is it? (TIMP description)	KARI Mbaazi 2 is a long duration variety which matures in 180-270 days. It is planted in the short rain season (October-November). It mainly a one season variety. It is high yielding with potential grain yield of 1300 kg/ha or 5.8 bags/acre. The plant is taller and stronger at lower altitudes (less than 1000 m) than at higher altitudes. The variety flowers in 60-90 days and has large pod and seed size (18-20 g/100 seeds).
Justification	ASALs are characterized by frequent drought leading to crop failure. Pigeonpea is a drought tolerant crop and can withstand drought for three months. The short and medium varieties (KARI Mbaazi 1 and KAT 60/8) have small seed size thus not preferred by farmers and consumers. KARI Mbaazi 2 has larger pods and seed size. Farmers varieties are highly susceptible to diseases like wilt.
B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Seed companies and Agro-dealers - Traders, Processors and Exporters - Other research organizations institutions including universities
Approaches to be used in dissemination	- Farmer participatory evaluation - On-farm demonstration

	- Field days - Agricultural shows - Farmer to farmer - Media – TV "Mkulima programme" - Extension publications (posters/ brochures/leaflets) - NGOs
Critical/essential factors for successful promotion	- Seed availability, accessibility and affordability - Strong linkage among pigeonpea value chain actors from production to market - Strong partnership linkages - Awareness campaign
Partners/stakeholders for scaling up and their roles	- KALRO will provide seed for the variety - Extension service providers (public and private) to help in technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - ICRISAT - technology dissemination - NGOs - technology dissemination through on-farm demonstrations - KILIMO trust - capacity building of farmers and linking farmers to markets and credit facilities - Seed companies - commercialization and marketing of the variety - Traders/exporters - marketing of the variety - Public institutions - schools (providing the market) - County governments - dissemination of the technology and linking farmers to external markets
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Kitui, and Tharaka Nithi
Counties where TIMPs will be up scaled	Machakos
Challenges in development and dissemination	- Limited seed systems hinder farmers from obtaining seed for new varieties due to low demand for certified seed by farmers as farmers use own saved seed - High cost of certified seed - Limited access to rural finance for pulse production - Low dry grain for export as most of the production is consumed as green peas - Low use of inputs since farmers have always grown their traditional crop with no inputs even when available
Suggestions for addressing the challenges	- Capacity building on GAPs - Participation of stakeholders along the value chain in technology development and on-farm validation - Promote awareness among farmers on the disadvantages of recycling of seed - Promote use of inputs to increase yields
Lessons learned	- Partnership is important in technology dissemination and adoption

	- Involvement of end-user in technology development process helps in faster adoption of the technology
Social, environmental, policy and market conditions necessary for development and upscaling	- Socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development and dissemination	Pigeonpea is a women's crop from production to marketing. Increased yields will therefore provide increased income for the women
Gender issues and concerns in adoption and scaling up	As a short duration and high yielding variety it will meet the food and nutrition security of the whole household
Gender related opportunities	Green peas are highly marketable therefore both men, women and youth can trade in it
VMG issues and concerns in development and dissemination	Most of the pigeonpea produced is consumed at the household level as green peas therefore it is important for improving the food and nutrition security
VMG issues and concerns in adoption and scaling up	The TIMPs are meant to increase the productivity therefore both gender can benefit from the increased production
VMG related opportunities	The technology can improve food and nutrition security and an opportunity for increased income
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide) in KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling 2. Requires validation
G: Contacts	
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Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, County government-Department of agriculture, FAO

GAPs

Need to work out the cost benefit analysis which is important for adoption and upscaling

2..1.1 TIMP Name	Pigeon pea variety Mituki

Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to limiting moisture and disease (wilt) damage
What is it? (TIMP description)	This is a medium duration pigeonpea variety which matures in 125-135 days. It can therefore be harvested twice in a year. It has high grain yield (1700 - 3500 kg /ha or 7.5 – 15.6 bags/acre in two seasons) and large pod size thus easy to shell and also large grain size (19 g/100 seeds) (Figure 10). It is rich in iron (70 ppm), tolerant to fusarium wilt and has good ratooning ability
Justification	ASALs are characterized by frequent drought leading to crop failure. Farmers' varieties are late maturing which gives only one harvest per year. Most of the early and short duration varieties that were released in 1990s are highly susceptible to fusarium wilt. The lines have also small pod and seed size making it difficult for shelling green peas and therefore not favourable to farmers
B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Seed companies and Agro-dealers - Traders, and Exporters - Other research organizations/institutions including universities
Approaches to be used in dissemination	- Farmer participatory evaluation - On-farm demonstration - Field days - Agricultural shows - Farmer to farmer - Media - TV "Mkulima programme" - Extension publications (posters/ brochures/leaflets) - NGOs
Critical/essential factors for successful promotion	- Seed availability, accessibility and affordability - Strong linkage among pigeonpea value chain actors from production to market - Strong partnership linkages - Awareness campaign
Partners/stakeholders for scaling up and their roles	- KALRO to prove improved varieties - Extension service providers (public and private) to help in technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - ICRISAT - technology dissemination - NGOs - technology dissemination through on-farm demonstrations - KILIMO trust - capacity building of farmers and linking farmers to markets and credit facilities

	- Seed companies - commercialization and marketing of the variety - Traders/exporters - marketing of the variety - Public institutions - schools (providing the market) - County governments - dissemination of the technology and linking farmers to external markets
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Kitui, and Tharaka Nithi.
Counties where TIMPs will be up scaled	Machakos
Challenges in development and dissemination	-Limited seed systems hinder farmers from obtaining seed for new varieties due to low demand for certified seed by farmers as farmers use own saved seed -High cost of certified seed -Limited access to rural finance for pulse production -Low dry grain for export as most of the production is consumed as green peas -Low use of inputs since farmers have always grown their traditional crop with no inputs even when available
Suggestions for addressing the challenges	-Capacity building on GAPs -Participation of stakeholders along the value chain in technology development and on-farm validation -Promote awareness among farmers on the disadvantages of recycling of seed -Promote use of inputs to increase yields
Lessons learned	-Partnership is important in technology dissemination and adoption -Involvement of end-user in technology development process helps in faster adoption of the technology
Social, environmental, policy and market conditions necessary for development and upscaling	- Socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 3 0,000
Estimated returns	Ksh 67,000 (for medium duration varieties)
Gender issues and concerns in development and dissemination	Pigeonpea is a women's crop from production to marketing. Increased yields will therefore provide increased income for the women
Gender issues and concerns in adoption and scaling up	As a short duration and high yielding variety it will meet the food and nutrition security of the whole household
Gender related opportunities	Green peas are highly marketable therefore both men, women and youth can trade in it
VMG issues and concerns in development and dissemination	Most of the pigeonpea produced is consumed at the household level as green peas therefore it is important for improving the food and nutrition security

VMG issues and concerns in adoption and scaling up	The TIMPs are meant to increase the productivity therefore both gender can benefit from the increased production
VMG related opportunities	The technology can improve food and nutrition security and an opportunity for increased income
E: Case studies/profiles of success stories	
Success stories	Mr. Wilson Lati Muli from Emali, Makueni county is one of the farmers who has adopted the variety: He sells the green peas (shelled and unshelled to hotels in Emali town. The foliage (empty pods) is used to make livestock cake.
Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide) in KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling 2. Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, County of agriculture, FAO

GAPs

Need to work out the yield potential under intercropping farming system

2..1.1 TIMP Nam	Pigeonpea variety Kajani
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to limiting moisture, disease (wilt) damage and low adoption of the earlier released varieties (KARI Mbaazi 1 and KAT 60/8) due to small pod and seed size
What is it? (TIMP description)	Pigeonpea variety Kijani is a medium duration variety (135-145 days to maturity) with high grain yield (2000 – 3500 kg/ha or 9 – 15.5 bags/acre per year) and large pod size, thus easy to shell. It has cream grain colour. It also has large grain size (20 g/100 seeds), is tolerant to fusarium wilt. It has good Ratooning ability.
Justification	ASALs are characterized by frequent drought leading to crop failure. Farmers' varieties are late maturing, giving only one harvest per year. Most of the early and short duration varieties that were released in 1990s are all highly susceptible to fusarium wilt. The lines have small pod and seed size making it difficult for shelling green peas. The variety Kajani has large pods and grain (20 g/100 seeds)

B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Seed companies and Agro-dealers - Traders, Processors and Exporters - Other research organizations/institutions including universities
Approaches to be used in dissemination	- Farmer participatory evaluation - On-farm demonstration - Field days - Agricultural shows - Farmer to farmer - Media - TV "Mkulima programme" - Extension publications (posters/ brochures/leaflets) - NGOs
Critical/essential factors for successful promotion	- Seed availability, accessibility and affordability - Strong linkage among pigeonpea value chain actors from production to market - Strong partnership linkages - Awareness campaign
Partners/stakeholders for scaling up and their roles	- KALRO to provide seed for the TIMP - Extension service providers (public and private) to help in technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - ICRISAT - technology dissemination - NGOs - technology dissemination through on-farm demonstrations - KILIMO trust - capacity building of farmers and linking farmers to markets and credit facilities - Seed companies - commercialization and marketing of the variety - Traders/exporters - marketing of the variety - Public institutions - schools (providing the market) - County governments - dissemination of the technology and linking farmers to external markets
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Kitui, and Tharaka Nithi.
Counties where TIMPs will be up scaled	Machakos
Challenges in development and dissemination	-Limited seed systems hinder farmers from obtaining seed for new varieties due to low demand for certified seed by farmers as farmers use own saved seed -High cost of certified seed -Limited access to rural finance for pulse production -Low dry grain for export as most of the production is consumed as green peas -Low use of inputs since farmers have always grown their traditional crop with no inputs even when available

Suggestions for addressing the challenges	-Capacity building on GAPs -Participation of stakeholders along the value chain in technology development and on-farm validation -Promote awareness among farmers on the disadvantages of recycling of seed -Promote use of inputs to increase yields
Lessons learned	-Partnership is important in technology dissemination and adoption -Involvement of end-user in technology development process helps in faster adoption of the technology -Its use as an intercrop or rotational crop in farming system enables efficient use and recycling of soil nutrients thus maintain soil productive capacity -The TIMP is very important for conservation farming (minimum or no tillage) therefore help to sustain and enhance the productivity of arable soils
Social, environmental, policy and market conditions necessary for development and upscaling	- Socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 30,000
Estimated returns	Ksh 67,000 (Gross margin was only done for medium duration varieties)
Gender issues and concerns in development and dissemination	Pigeonpea is a women's crop from production to marketing. Increased yields will therefore provide increased income for the women
Gender issues and concerns in adoption and scaling up	As a short duration and high yielding variety it will meet the food and nutrition security of the whole household
Gender related opportunities	Green peas are highly marketable therefore both men, women and youth can trade in it
VMG issues and concerns in development and dissemination	Most of the pigeonpea produced is consumed at the household level as green peas therefore it is important for improving the food and nutrition security
VMG issues and concerns in adoption and scaling up	The TIMPs are meant to increase the productivity therefore both gender can benefit from the increased production
VMG related opportunities	The technology can improve food and nutrition security and an opportunity for increased income
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide) available in KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling

G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, County government - Department of agriculture, FAO

GAPs for further Research

Need to work out the cost benefit analysis which is important for adoption and upscaling.

2..1.1 TIMP Name	Egerton Mbaazi 1
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity, due to water scarcity and low yielding varieties
What is it? (TIMP description)	Egerton Mbaazi 1 is a meduin duration (140-160 days) pigeon pea variety. The plant is also compact and is normally grown as a sole crop. The variety has potential yields of 1400 - 2800 kg/ha or 8-18 bags total annual harvest. It is tolerant to fusarium wilt disease. Seed is cream coloured an preferred by farmers
Justification	ASALs are characterized by frequent drought leading to crop failure. Farmers' varieties are late maturing with only one harvest per year. Besides maturing early due to shorter growing period, Egerton Mbaazi 1 facilitates crop intensification and thus helps in improving productivity especially in low rainfall conditions. The variety can give two harvests per year as compared to local long duration lines. Multiple harvests ensures continuous food security at the household level.
B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Farmers - Seed companies and Agro-dealers - Traders, Processors and Exporters - Other research organizations/institutions including universities
Approaches to be used in dissemination	- Farmer participatory evaluation - On-farm demonstration - Field days - Agricultural shows - Farmer to farmer - Media - TV "Mkulima programme" - Extension publications (posters/ brochures/leaflets) - NGOs
Critical/essential factors for successful promotion	- Seed availability, accessibility and affordability

	- Strong linkage among pigeonpea value chain actors from production to market - Strong partnership linkages - Awareness campaign
Partners/stakeholders for scaling up and their roles	- Egerton Univerity and ICRISAT provide seed for the variety - Extension service providers (public and private) to help in technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - ICRISAT - technology dissemination - NGOs - technology dissemination through on-farm demonstrations - KILIMO trust - capacity building of farmers and linking farmers to markets and credit facilities - Seed companies - commercialization and marketing of the variety - Traders/exporters - marketing of the variety - Public institutions - schools (providing the market) - County governments - dissemination of the technology and linking farmers to external markets
C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Elgeyo Marakwet, Baringo
Counties where TIMPs will be up scaled	Machakos
Challenges in development and dissemination	-Limited seed systems hinder farmers from obtaining seed for new varieties due to low demand for certified seed by farmers as farmers use own saved seed -High cost of certified seed -Limited access to rural finance for pulse production -Low dry grain for export as most of the production is consumed as green peas -Low use of inputs since farmers have always grown their traditional crop with no inputs even when available
Suggestions for addressing the challenges	-Capacity building on GAPs -Participation of stakeholders along the value chain in technology development and on-farm validation -Promote awareness among farmers on the disadvantages of recycling of seed -Promote use of inputs to increase yields
Lessons learned	-Partnership is important in technology dissemination and adoption -Involvement of end-user in technology development process helps in faster adoption of the technology
Social, environmental, policy and market conditions necessary for development and upscaling	- Socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 30,000
Estimated returns	Ksh 67,000 (for medium duration varieties)
Gender issues and concerns in development and dissemination	Pigeonpea is a women's crop from production to marketing. Increased yields will therefore provide increased income for the women
Gender issues and concerns in adoption and scaling up	As a short duration and high yielding variety it will meet the food and nutrition security of the whole household
Gender related opportunities	Green peas are highly marketable therefore both men, women and youth can trade in it
VMG issues and concerns in development and dissemination	Most of the pigeonpea produced is consumed at the household level as green peas therefore it is important for improving the food and nutrition security
VMG issues and concerns in adoption and scaling up	The TIMPs are meant to increase the productivity therefore both gender can benefit from the increased production
VMG related opportunities	The technology can improve food and nutrition security and an opportunity for increased income
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide)
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	Ready for upscaling 2. Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, Ministry of agriculture, FAO

GAPs

Further research to improve its small seed size

Need to work out the cost benefit analysis which is important for adoption and upscaling

2.2 Good Agronomic Practices (GAPs)

2..1.1 TIMP Name	Good Agronomic practices
Category (i.e. technology, innovation or management practice)	**Management practice**
A: Description of the technology, innovation or management practice	

Problem addressed	Low productivity due to drought, poor crop husbandry like planting method, plant population, field management, soil and water management related challenges
What is it? (TIMP description)	Crop husbandry, Good Agronomic Practices are a set of principles, regulations and technical recommendations applicable to production and processing addressing human health care environment protection. GAPs foster environment by rational handling of agro-chemicals Example. Proper spacing for different maturity types types (Short duration: 1 x 0.3 m; Medium duration 1.2 x 0.5 m and Long duration 1.5 x 0.5 m), Type of fertilizer and the quantity
Justification	ASALs are characterized by frequent drought leading to crop failure. Pigeonpea is grown in the ASALs which are characterized by low poorly distributed rainfall, and declining soil fertility. Planted as a bonus crop therefore farmers do not use improved management practices. Pigeonpea cultivation is done by smallholder farmers with minimal inputs application - (fertilizer, spacing, crop protection, post-harvest). Farmers drill the seed during planting and do not thin leading to overpopulation and competition for water and soil nutrients which lowers the yield
B. Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers by obtaining healthy and good quality food to assure their nutrition and nourishment, generating a value added in their products to access markets in a better way. • Extension service providers
Approaches to be used in dissemination	• Farmer Participatory Evaluation • On-farm demonstrations • Field days • MoAF&I/Extension officers • Partners (FAO, ICRISAT, Farm Inputs Promotions FIPs, County government –Department of Agriculture) • Farmer to farmer • Promotional materials (posters/brochures/leaflets, manuals)
Critical/essential factors for successful promotion	• Awareness creation on importance of GAPs –e.g. fertilizer use, spacing • Capacity building on the importance of GAPs • Suitability of the TIMP to the agroclimatic and socio-economic condition of the farmer eg Affordable mechanized tools will be easy to promote • Accessibility of the TIMP by the farmers
Partners/stakeholders for scaling up and their roles	• KALRO to provide improved agronomic practices • Extension service providers eg County officers, KILIMO trust and other NGOs • FAO – promotion of Conservation Agriculture, • Cereal Growers Association (CGA) • Faith based organizations
C: Current situation and future scaling up	

Counties where already promoted, if any	Makueni, Kitui
Counties where TIMPs will be up scaled	Machakos
Challenges in dissemination	- Cultural beliefs by some farmers like fertilizer destroys soils - The myth that being a legume pigeonpea is a nitrogen fixing crop thus no inputs is applied even when available - Limited access to rural finance for pulse production to purchase inputs like seed and fertilizer
Suggestions for addressing the challenges	- Creation of awareness on GAPs - Participation of end-user in on-farm activities/extension activities - Promoting awareness among farmers about the declining soil fertility and importance of its improvement for increased crop productivity - Training stakeholders on GAPs along the value chain especially extension service providers, input suppliers and finance institutions
Lessons learned	- Despite the importance of pigeonpea as a food security and income generating agro-enterprise, it is mostly grown as a bonus crop - Low use of certified seed for improved pigeonpea varieties with farmers still growing their traditional landraces due to poor seed system. - Low application of recommended production practices – spacing, fertilizer application, timely and correct doses for chemicals - Partnership is important in technology dissemination and adoption - Involvement of end-user in technology development process helps in faster adoption of the technology
Social, environmental, policy and market conditions necessary for development and upscaling	- Commodity is socially acceptable - Conducive environment for pigeonpea production - Market will absorb the increased production - Supporting frameworks and policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development and dissemination	Pigeon pea is a women's crop, (planting to shelling) and marketing done mainly by women. Most marketed product is inform of green peas. Increased yields will thus provide increased incomes for the household
Gender issues and concerns in adoption and scaling up	Increased productivity will benefit the household
Gender related opportunities	Increased productivity will benefit the household

VMG issues and concerns in development and dissemination	The TIMPs are meant to increase the productivity therefore both gender can benefit from the increased production
VMG issues and concerns in adoption and scaling up	The management practice is aimed increasing production and therefore providing food and nutrition security and a window for increased income.
VMG related opportunities	The management practice is aimed increasing production and therefore providing food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Guidelines available in brochures and manuals (Pigeonpea production guide) in KALRO
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling 2 Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 736333294
Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	ICRISAT, Egerton university, Ministry of agriculture, FAO

GAPs

Need to work out the cost benefit analysis which is important for adoption and upscaling

2.3 Integrated Disease Management

2.3.1 TIMP Name	**Integrated Disease Management of Fusarium wilt**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss and poor-quality grain due to fusarium wilt disease
What is it? (TIMP description)	Integrated disease management (IDM) involves a sustainable approach to managing diseases by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks Cultural practices: Cultivation techniques, mulching, intercropping, crop rotation, rouging, healthy planting material can be used as tools for disease management. **Biological control** use by use of naturally occurring bio-control agents (antagonists). Adding composts or manures, which enrich the soil with antagonistic microflora.
Justification	Fusarium wilt is a major constraint in pigeonpea production. The disease is common in areas where the crop is continuously especially in small-scale farms.

	The disease causes severe wilting and death of the plants. Grain losses due to wilt vary from negligible amount to 100% depending on the stage of the crop and environmental factors. For instance, it can approach 100% when it occurs before pod development, about 67% when it occurs at maturity, and 30% when it occurs at the pre-harvest stages.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Farmers • Extension officers
Approaches used in dissemination	• On-farm demonstration • Farmer field days • Farmer Field Schools • Partners (FAO, service providers)
Critical/essential factors for successful promotion	• Strong partnership linkages • Enabeling environment for the successful implementation of IDM strategies • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	- Extension service providers (Public and private) to help in the technology dissemination - FAO facilitate in the promotion of the technology and linking farmers to market - County governments –Help in the dissemination of the technology, Linking farmers to external markets
C: Current situation and future scaling up	
Counties where already promoted, if any	
Counties where TIMPs will be upscaled	Machakos, Nyeri, Tharaka Nithi,
Challenges in dissemination	Farmers are less receptive on aspects of rotation to manage the disease especially where the crop is ratooned for several seasons
Suggestions for addressing the challenges	• Create awareness on the economic importance of the disease • Train farmers on disease symptoms • Training on IDM practices through on-farm demonstrations
Lessons learned in up scaling, if any	- More than one approach is used in management of major diseases - IDM is environment friendly and the chemical component should only be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the

	disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	• Need to understand the physical and biotic environment in target ecologies; community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market is available to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development and dissemination	IDM is cheap and reduces production costs therefore user friendly to resource poor women
Gender issues and concerns in adoption and scaling up	IDM protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender. Setting of traps may create income generation opportunity for the youth
Gender related opportunities	Opportunities for youth employment in implementing IDM protocols Opportunities in marketing pest traps
VMG issues and concerns in development and dissemination	The TIMPs are meant to reduce the production costs therefore women can afford to produce the technology
VMG issues and concerns in adoption and scaling up	The TIMPs are meant to reduce the production costs therefore women can afford to produce the technology
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	None
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research**)**	1 Ready for upscaling 2 requires validation - crop rotation and intercropping for Disease control 3 requires further research **–(Possibility for Biocontrol)**
G. Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO Sila Nzio, Rael Karimi (Katumani), Catherine Muriithi (KALRO-Embu)
Partner organizations	Ministry of agriculture FAO ICRISAT Egerton University East African Grain Council

GAPs for further Research
Need to work out the cost benefit analysis which is important for adoption and upscaling

2.2 Integrated Pest Management

2.2.1 TIMP name	Integrated Pest Management of pod borers, pod sucking bugs, pod fly
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss and low grain quality due to white fly damage
What is it? (TIMP description)	Integrated pest management (IPM) involves minimal use of pesticides, and only if deemed necessary, giving preference to other control methods such as host-plant resistance, cultural practices and biological control. Cultural control: Rotation of pigeonpea with non-host crop like cereals Biological: Use of predators, use yellow sticky traps at the rate of 10-12 traps/ha Chemical: Use of insecticides
Justification	Pests are a major constraint in pigeon pea production causing significant grain losses. IPM is an environment friendly (minimises use of chemicals) approach to pest management which will help alleviate yield losses due to pest infestation and damage
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and extension officers
Approaches used to be used in dissemination	- Extension publications - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them eg Use of Indegenoue Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	Service providers (private and public), FAO, County governments – KALRO, universities (department of crop protection) to provide the guidelines and trainings County government-Department of Agriculture to provide extension services especially capacity building

C: Current situation and future scaling up	
Counties where already promoted, if any	Makueni, Kitui
Counties where TIMPs will be upscaled	Machakos
Challenges in dissemination	Farmers are less receptive especially on aspects of intercropping to manage pests e.g. push-pull technologies for pest management
Suggestions for addressing the challenges	Training on integrated pest management practices
Lessons learned in up scaling, if any	- Need to use more than one approach for effective management of insect pests - IPM is environment friendly and the chemical component should be used as the last resort - IPM approaches are knowledge intensive and location-specific, farmers would need to understand the agro-ecological processes affecting the pest infestation to be able to make informed decisions on how to manage crop to avoid pest occurrence, as well as how to manage the pests once they become a problem. This will require a capacity building on crop monitoring, identification and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	- Understand the physical and biotic environment in target ecologies, community culture, preferences, and practices - Training on IPM to increase awareness of IPM and reduce possible negative impact on the environment resulting from wrong application of IPM - Market is able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development and dissemination	The TIMPs are meant to reduce the production costs therefore women can afford to produce the technology
Gender issues and concerns in adoption and scaling up	IPM protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender. Setting of traps may create income generation opportunity for the youth
Gender related opportunities	Opportunities for youth employment in implementing IPM protocols Opportunities in marketing pest traps
VMG issues and concerns in development and dissemination	The TIMPs are meant to reduce the production costs therefore women can afford to produce the technology
VMG issues and concerns in adoption and scaling up	The TIMPs are meant to reduce the production costs therefore women can afford to produce the technology
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
E: Case studies/profiles of success stories	

Success stories	-
Application guidelines for users	Extension publications not yet developed
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation 3-requires further research)
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: cd.katumani@kalro.org; Phone: 0736333294
Lead organization and scientists	KALRO-Katumani, Rael Karimi
Partner organizations	- Extension service providers (Public and private) to help in the technology dissemination - FAO to facilitate in the promotion of the technology - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology,

GAPs

Need to work out the cost benefit analysis which is important for adoption and upscaling