



***DRAFT***

**INVENTORY OF CLIMATE SMART AGRICULTURE  
GREEN GRAMS TECHNOLOGIES, INNOVATIONS &  
MANAGEMENT PRACTICES**

**Compiled by**

Rael Karimi; Daniel Mutisya, Evans Mutuma; Catherine  
Muriithi' and Arnold Njaimwe

**Kenya Agricultural and Livestock Research Organization**

**Under**

**KENYA CLIMATE SMART AGRICULTURE  
PROJECT  
(KCSAP)**

**April 2019**

**Version 1**

## **1.0 Definition of terms and summary tables of Greengrams 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 Greengrams Value Chain

The inventory process resulted in a total of 8 TIMPs including 5 technologies, 0 innovations and 9 management practices, distributed among the 5 sub-themes, as indicated in Table 1

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Greengrams	Improved varieties	5	0	0
Greengrams	Integrated Pest and Disease Management	0	0	2
Greengrams	Integrated Soil Fertility management	0	0	4
Greengrams	Agronomic practices	0	0	1
Greengrams	Postharvest management			2
<b>Overall Total</b>		<b>5</b>	<b>0</b>	<b>9</b>

## 1.3 Summary of Status of TIMPs in Green gram Value Chain

The inventory process resulted in a total of 13 TIMPs that are ready for upscaling, 13 TIMPs that require validation and 6 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
Greengrams	Improved varieties	5	5	2
Greengrams	Integrated Pest and Disease Management	2	2	0
Greengrams	Integrated Soil Fertility Management	3	3	0
Greengrams	Agronomic practices	1	1	0
Greengrams	Green gram value added products	0	0	1
Greengrams	Mechanization	0	0	1
Greengrams	Postharvest handling	2	2	2
<b>Overall Total</b>		<b>13</b>	<b>13</b>	<b>6</b>

**Table3: Inventory of Greengram TIMPs by Category and Status**

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
2.1 Improved varieties	2.1.1 Green Gram variety KAT N26	Technology	Ready for upscaling
	2.1.2 Green gram variety Biashara	Technology	Ready for upscaling <b>Requires validation</b>
	2.1.3 Green gram variety Ndengu Tosha	Technology	Ready for upscaling <b>Requires validation</b>
	2.1.4 Green Gram variety Karembo	Technology	Ready for upscaling <b>Requires validation</b>
	2.1.5 Variety KS 20	Technology	Ready for up scaling
<b>2.2 Integrated Pest Management</b>	2.2.1 Integrated Pest and Disease Management	Management Practice	Ready for upscaling <b>Requires validation</b>
<b>2.3 Fertility management</b>	2.3.1 Integrated soil fertility management (ISFM) –Tied ridges, CA, rotational, Use of fertilizer/manure	Management Practice	Ready for upscaling <b>Requires validation</b>
<b>2.4 Agronomic practices</b>	2.4.1 Recommended spacing, Seed rate	Management Practice	Ready for upscaling <b>Requires validation</b>

## 2.0 Detailed Green gram Value chain TIMPS

### 2.1 Improved varieties

<b>2.1.1TIMP name</b>	Green Gram variety KAT N26
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	<ul style="list-style-type: none"> <li>- Low green gram yields</li> <li>- High demand for green grams</li> </ul>
What is it? (TIMP description)	<p>It is an Early maturing (80-90 days), high yielding (1000-1500kg/ha (4-6, 90 kg bags/acre) green gram variety that is tolerant to aphids, resistant to yellow mosaic and moderately resistant to powdery mildew. Its characteristic features include; black pod colour when dry and shiny green grains. Green gram grows in a wide range of climatic conditions. It is a low altitude, warm season crop and can be grown from sea level to 1600 m above sea level. The crop is also heat and drought tolerant and thus can be grown in both semi-arid and well-watered areas. A warm humid climate with temperature ranging from 25- 35 °C, 400-550 mm rainfall, well distributed during the growing period is suitable for cultivation. Green gram is grown on a wide range of soils. A well-drained loamy and sandy loam soil are best for its cultivation. The crop does not grow well in waterlogged soils.</p>
Justification	<p>ASALs are characterized by frequent droughts. Green gram is a short season legume and can fit into cropping patterns practiced in ASALs (two season cropping). Farmer varieties are low yielding and late maturing. This early maturing, high yielding, pest and disease tolerant variety will increase yields and improve livelihoods. Due to their short growing cycle (65-75 days), green gram are considered less risk-prone. It is a nutritious warm season crop. The grain is abundant in protein, minerals and vitamins making it an ideal supplement to cereal-based diet which is the best solution to protein-calorie malnutrition. Its starch is easier to digest. It induces less flatulence and is well tolerated by children. Wide adoption of the improved varieties will play an important role in food security, balanced diet and alleviation of poverty.</p>
<b>B.. Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Seed companies/Agro-dealers</li> <li>- Traders/Exporters,</li> <li>- Research organizations and universities</li> <li>- Agro-processors</li> <li>- Extension Agents (Public and Private)</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>- Farmer participatory evaluation</li> <li>- On-farm demonstration</li> <li>- Field days</li> </ul>

	<ul style="list-style-type: none"> <li>- Agricultural shows</li> <li>- Farmer to farmer</li> <li>- Mass Media – e.g. Mkulima programme, Smart Farmer and Seeds of Gold</li> <li>- Extension publications (posters/ brochures/leaflets)</li> <li>- Partners -NGOs</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Seed availability, accessibility and affordability</li> <li>- Strong linkage among green gram value chain actors – producers to market</li> <li>- Strong partnership linkages</li> <li>- Awareness campaign</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private) to help in the technology dissemination</li> <li>- FAO facilitate in the promotion of the technology and linking farmers to market</li> <li>- ICRISAT –technology dissemination</li> <li>- NGOs:–technology dissemination through on-farm demonstrations</li> <li>- KILIMO trust capacity building of farmers and linking farmers to markets and credit facilities</li> <li>- Seed companies -marketing of the technologies</li> <li>- Traders/exporters –marketing of the technology</li> <li>- Processors –For value added products</li> <li>- Public institutions – schools (Providing the market)</li> <li>- County governments –Help in the dissemination of the technology, Linking farmers to external markets</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Some parts of Makueni, Kitui, and Tharaka Nithi.
Counties where TIMPs will be up scaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>- Limited seed systems hinder farmers from obtaining seed for new varieties</li> <li>- Unavailability of quality seed and high seed cost</li> <li>- Limited access to rural finance for pulse production</li> <li>- Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Capacity building on Good Agronomic Practices</li> <li>- Participation of stakeholders along the value chain in technology development and on-farm validation</li> <li>- Promoting awareness among farmers about the loss of varietal vigour associated with recycling of saved seed</li> <li>- Upscale innovations to reduce production costs</li> <li>- Develop value added products</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- Partnership is important in technology dissemination and adoption</li> </ul>
Social, environmental, policy and market conditions	<ul style="list-style-type: none"> <li>- Re-establish linkage between green gram production and consumption -importance in the local diet</li> </ul>

necessary for development and upscaling	<ul style="list-style-type: none"> <li>- Use of contract management as a means to guarantee consistent supply</li> <li>- Increase Public-Private dialogue to agree on a model that will ensure compliance with international standards</li> <li>- Provide market information on volume, quality and supply consistency requirements</li> <li>- Support informal seed system (community seed bulking) to ensure timely seed availability, access and affordability</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Kshs.13,000
Estimated returns	The gross margins under improved management were estimated at KES 19,858.80/ha
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> <li>- It offers a good opportunity for income generation for both men and women</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>- The variety is high yielding therefore Increased productivity will benefit the household</li> <li>- The technology has high international and local demand therefore offers an opportunity for men, women and the youth to generate income</li> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- The variety is meant to increase productivity, therefore both gender can benefit from the increased production</li> <li>- Being a high yielding variety, it is aimed at increasing production and therefore providing food and nutrition security and a window for increased income</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>- The technology can improve food and nutrition security and an opportunity for increased income</li> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household.</li> <li>- It offers a good opportunity for income generation for the whole family</li> <li>- The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	
Application guidelines for users	Guidelines available in extension publications (Green gram brochures available at KALRO-Katumani)
<b>F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)</b>	<ul style="list-style-type: none"> <li>1-Ready for upscaling</li> <li>2-requires validation</li> <li>3-requires further research on disease resistance</li> </ul>
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0736333294

Lead organization and scientists	KALRO, Rael Karimi, Daniel Mutisya and Arnold Njaimwe (KALRO Katumani), Catherine Muriithi (KALRO Embu)
Partner organizations	<ul style="list-style-type: none"> <li>- World Vegetable Centre</li> <li>- MoALF&amp;I</li> <li>- Seed companies like Dryland seed Ltd, East African Seed company</li> <li>- FAO</li> <li>- ICRISAT</li> <li>- KILIMO trust</li> <li>- East African Grain Council</li> </ul>

**Gaps for further researcher:**

1. Need for mechanization to ease the harvesting – Thresher
2. Need to improve KAT N26 variety on disease resistance
3. Explore bio-control of insect pests – white flies and aphids
4. Postharvest handling – protection against pests e. g rat-proof cages for protection of hermetic bags
5. Value added green gram based products – formulation of weaner diets

<b>2.1.2TIMP name</b>	Green gram variety Biashara
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields High demand for green grams
What is it? (TIMP description)	It is an early maturing (65 –75 days) high yielding (1800—2100 kg/ha (8-9, 90 kg bags/acre) green gram variety that is tolerant to aphids, resistant to yellow mosaic and moderately resistant to powdery mildew. Its characteristic features include; cream pod colour when dry large seed size (8 –10 g/100 seeds), and shiny green grains. Optimal environmental conditions: The crop grows in a wide range of climatic conditions. It is a low altitude, warm season crop and can be grown from sea level to 1600 m above sea level. It is heat and drought tolerant and thus can be grown in both semi-arid and well-watered areas. A warm humid climate with temperature ranging from 25- 35 °C, 400-550 mm rainfall, well distributed during the growing period is suitable for cultivation. A well-drained loamy and sandy loam soil are best for its cultivation. The crop does not grow well in waterlogged soils.
Justification	ASALs are characterized by frequent droughts. Green grams is a short season legume and can fit into cropping patterns practiced in ASALs (two season cropping). Farmer available varieties are low yielding and late maturing. Conventional varieties, however have small pods and small seeds that are difficult to harvest. The small seed is undesirable in the market. This early maturing, high yield, pest and disease tolerant variety will increase yields and improve livelihoods.



	Due to their short growing cycle (65-75 days), green gram are considered less risk-prone. It is a nutritious warm season crop. The grain is abundant in protein, minerals and vitamins making it an ideal supplement to cereal-based diet which is the best solution to protein-calorie malnutrition. Its starch is easier to digest. It induces less flatulence and is well tolerated by children. Wide adoption of the improved varieties will play an important role in food security, balanced diet and alleviation of poverty.
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Seed companies and Agro-dealers</li> <li>- Traders/Exporters</li> <li>- Other research organizations/institutions (universities)</li> <li>- Processors</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>- Farmer participatory evaluation</li> <li>- On-farm demonstration</li> <li>- Field days</li> <li>- Agricultural shows</li> <li>- Farmer to farmer</li> <li>- Mass Media – “Mkulima programme”</li> <li>- Promotional materials (posters/brochures/leaflets)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Need for good seed system to ensure accessibility</li> <li>- Strong linkage among green gram value chain actors – producers to market</li> <li>- Strong Partnership linkages</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- KALRO to provide seed for the variety</li> <li>- Extension service providers (Public and private) to help in the technology dissemination</li> <li>- FAO facilitate in the promotion of the technology and linking farmers to market</li> <li>- ICRISAT –technology dissemination</li> <li>- NGOs:–technology dissemination through on-farm demonstrations</li> <li>- KILIMO trust capacity building of farmers and linking farmers to markets and credit facilities</li> <li>- Seed companies –marketing of the technologies</li> <li>- Traders/exporters–marketing of the technology</li> <li>- Processors</li> <li>- Public institutions – schools (Providing of the market)</li> <li>- County governments –Help in the dissemination of the technology, Linking farmers to external markets</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>- Limited seed systems hinder farmers from obtaining seed for new varieties</li> <li>- Unavailability of quality seed and high seed cost</li> <li>- Limited access to rural finance for pulse production</li> </ul>

	<ul style="list-style-type: none"> <li>- Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Need for information dissemination on GAPs</li> <li>- Participation of stakeholders along the value chain in technology development and on-farm validation</li> <li>- Promoting awareness among farmers about the loss of varietal vigor associated with recycling of saved seed</li> <li>- Upscale innovations to reduce production costs</li> <li>- Develop value added products – need to strengthen linkages between green gram production and consumption in local food systems (develop weaner diet)</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- Partnerships are important in technology dissemination and adoption</li> <li>- Increased yield can be achieved through application of water harvesting techniques and agro-ecological technologies (conservation farming like minimum tillage, mulching)</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>- Re-establish linkage between green gram production and consumption -importance in the local diet</li> <li>- Use of contract management to guarantee consistent supply</li> <li>- Increase public-private dialogue to agree on a model that will ensure compliance with international standards</li> <li>- Provide market information on volume, quality and supply consistency requirements</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Kshs.13,000
Estimated returns	The gross margins under improved management were estimated at KES 19,858.80/ha
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> <li>- It offers a good opportunity for income generation for both men and women</li> </ul>
Gender related opportunities	The technology can benefit men, women and the youth to generate income
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>- The crop is important for food and nutrition security there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household.</li> <li>- It offers a good opportunity for income generation for both men and women</li> <li>- The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Samuel Mukosa, an early adopter who is now growing and selling to other farmers in Mbuvo, Makueni county
Application guidelines for users	Guidelines available in extension publications (Green gram brochures available at KALRO-Katumani)

<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation
<b>G: Contacts</b>	
Contacts	Center Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, Arnold Njaimwe and Daniel Mutisya (Katumani), Catherine Muriithi (Embu)
Partner organizations	World Vegetable Centre Ministry of agriculture Seed companies – Dryland seed ltd, East African Seed company FAO ICRISAT KILIMO trust East African Grain Council

#### Gaps for further researcher:

1. Need for mechanization to ease the harvesting – Thresher
2. Explore bio-control of insect pests – white flies and aphids
3. Postharvest handling – protection against pests e. g rat-proof cages for protection of hermetic bags
4. Value added green gram based products – formulation of weaner diets

<b>2.1.3 TIMP name</b>	Green gram variety Ndengu Tosha
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields High demand for green grams
What is it? (TIMP description)	It is an early maturing (65 –70 days), high yielding (1800-2300 kg/ha (8-10, 90 kg bags/acre) green gram variety. Its characteristic features include; cream pod colour when dry and shiny green grains. Optimal environmental conditions: The green gram variety grows in a wide range of climatic conditions. It is a low altitude, warm season crop and can be grown from sea level to 1600 m above sea level. The crop is also both heat and drought tolerant and thus can be grown in both semi-arid and well-watered areas. A warm humid climate with temperature ranging from 25- 35 °C, 400-550 mm rainfall, well distributed during the growing period is suitable for

	cultivation. A well-drained loamy and sandy loam soil are best for its cultivation. The crop does not grow well in waterlogged soils.
Justification	ASALs are characterized by frequent droughts. Green grams is a short season legume and can fit into cropping patterns practiced in ASALs (two season cropping). Farmer available varieties are low yielding and late maturing. Conventional varieties however, have small pod sizes and are also small and difficult to harvest. The small seed is undesirable in the market. This early maturing, high yield variety will increase yields and improve livelihoods. Due to their short growing cycle (65-75 days), green gram are considered less risk-prone. It is a nutritious warm season crop. The grain is abundant in protein, minerals and vitamins making it an ideal supplement to cereal-based diet which is the best solution to protein-calorie malnutrition. Its starch is easier to digest. It induces less flatulence and is well tolerated by children. Wide adoption of the improved varieties will play an important role in food security, balanced diet and alleviation of poverty.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Seed companies/Agro-dealers</li> <li>- Traders/Exporters</li> <li>- Other research organizations/institutions (universities)</li> <li>- Processors</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>- Farmer Participatory Evaluation exercises</li> <li>- On-farm demonstration</li> <li>- Field days</li> <li>- Agricultural shows</li> <li>- Farmer to farmer</li> <li>- Mass Media –e.g. Mkulima programme on KBC</li> <li>- Promotional materials (posters/brochures/leaflets)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Need for good seed system to improve seed availability and accessibility</li> <li>- Strong linkage among green gram value chain actors from producers to markets</li> <li>- Strong Partnership linkages</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private) to help in the technology dissemination</li> <li>- FAO facilitates in the promotion of the technology and linking farmers to market</li> <li>- ICRISAT –technology dissemination</li> <li>- NGOs: technology dissemination through on-farm demonstrations</li> <li>- KILIMO trust capacity building of farmers and linking farmers to markets and credit facilities</li> <li>- Seed companies –marketing of the technologies</li> <li>- Traders/exporters –marketing of the technology</li> <li>- Processors –For value added products</li> <li>- Public institutions – schools (Providing of the market)</li> </ul>

	<ul style="list-style-type: none"> <li>- County governments –Help in the dissemination of the technology, Linking farmers to external markets</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>- Limited seed systems hinder farmers from obtaining seed for new varieties</li> <li>- Unavailability of quality seed and high seed cost</li> <li>- Limited access to rural finance for pulse production</li> <li>- Limited processing technologies at the household level; it is mainly known for making stew served with cereal-based meals</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Need for information dissemination on GAPs</li> <li>- Participation of stakeholders along the value chain in technology development and on-farm validation</li> <li>- Promoting awareness among farmers about the loss of varietal vigour associated with recycling of saved seed</li> <li>- Upscale innovations to reduce production costs</li> <li>- Develop value added products – need to strengthen linkages between green gram production and consumption in local food systems (develop weaner diet)</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>- Partnership is important in technology dissemination and adoption</li> <li>- Involvement of end-user in technology development process eliminates the problem of fitting the crop to both the target environments and users’ preferences</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>- Re-establish linkage between green gram production and consumption and importance in the local diet</li> <li>- Use of contract management to secure supply-side conditions guarantee consistent supply</li> <li>- Increase public private dialogue to agree on a model that will ensure compliance with international standards</li> <li>- Provision of improved market information on volume, quality and supply consistency requirements</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Kshs. 13,000
Estimated returns	The gross margins under improved management were estimated at KES 19,858.80/ha
Gender issues and concerns in development dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> <li>- It offers a good opportunity for income generation for both men and women</li> </ul>
Gender related opportunities	The technology can benefit men, women and the youth to generate income
VMG issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- The crop is important for food and nutrition security there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> </ul>

	<ul style="list-style-type: none"> <li>- Due to the crop's importance for food and nutrition security, there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> <li>- Need for mechanization to ease drudgery at harvesting</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household.</li> <li>- It offers a good opportunity for income generation for both men and women</li> <li>- The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	
Application guidelines for users	Guidelines available in extension publications (Green gram pamphlets available at KALRO-Katumani)
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation,
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Telephone: 0736333294
Lead organization and scientists	KALRO, Rael Karimi, <b>Arnold Njaimwe</b> and Daniel Mutisya (KALRO Katumani), Catherine Muriithi (KALRO Embu)
Partner organizations	<ul style="list-style-type: none"> <li>- World Vegetable Centre</li> <li>- M0ALF&amp;I</li> <li>- Seed companies-Dryland seed Ltd, East African Seed company</li> <li>- FAO</li> <li>- ICRISAT</li> <li>- KILIMO trust</li> <li>- East African Grain Council</li> </ul>

#### GAPs for further research

1. Need for mechanization to ease the harvesting – Thresher
2. Explore bio-control of insect pests – white flies and aphids
3. Postharvest handling – protection against pests e. g rat-proof cages for protection of hermetic bags
4. Value added green gram based products – formulation of weaner diets

<b>2.1.4 TIMP name</b>	Green Gram variety Karembo
Category (i.e. technology, innovation or management practice)	Technology

<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	<p>Low green gram yields</p> <ul style="list-style-type: none"> <li>- High demand for green grams</li> </ul>
What is it? (TIMP description)	<p>An early maturing (65-75 days), high yielding (1800-2100 kg/ha 8-9, 90 kg bags/acre) green gram variety that is tolerant to major green gram diseases. Its characteristic features include; brown pods, green shiny grains and large seed size (8 –10 g/100 seeds). Dry pods are brown in colour and the grain has shiny green colour. Green gram grows in a wide range of climatic conditions. It is a low altitude, warm season crop and can be grown from sea level to 1600 m above sea level. The crop is also both heat and drought tolerant and thus can be grown in both semi-arid and well-watered areas. A warm humid climate with temperature ranging from 25- 35 °C, 400-550 mm rainfall, well distributed during the growing period is suitable for cultivation. A well-drained loamy and sandy loam soil are best for its cultivation. The crop does not grow well in waterlogged soils.</p>
Justification	<p>ASALs are characterized by frequent drought. Farmer available cultivars are low yielding and late maturing. Pod size is also small and difficult to harvest with small seed which are undesirable in the market. This early maturing, high yield variety will increase yields and improve livelihoods. Due to their short growing cycle (65-75 days), green gram are considered less risk-prone. It is a nutritious warm season crop. The grain is abundant in protein, minerals and vitamins making it an ideal supplement to cereal-based diet which is the best solution to protein-calorie malnutrition. Its starch is easier to digest and induces less flatulence and is well tolerated by children. Wide adoption of the improved varieties will play an important role in food security, balanced diet and alleviation of poverty.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Seed companies/Agro-dealers</li> <li>- Traders/Exporters</li> <li>- Other research organizations/institutions (universities)</li> <li>- Processors</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>- Farmer Participatory Evaluation</li> <li>- On-farm demonstrations</li> <li>- Field days</li> <li>- Agricultural shows</li> <li>- Farmer to farmer</li> <li>- Mass Media e.g Mkulima programme, Smart Farmer and Seeds of Gold</li> <li>- Promotional materials (posters/brochures/leaflets)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Good seed system to improve seed availability and accessibility</li> <li>- Strong linkage among green gram value chain actors – producers to market</li> </ul>

	<ul style="list-style-type: none"> <li>- Strong partnership linkages</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private) to help in the technology dissemination</li> <li>- FAO facilitate in the promotion of the technology and linking farmers to market</li> <li>- ICRISAT –technology dissemination</li> <li>- NGOs: technology dissemination through on-farm demonstrations</li> <li>- KILIMO trust capacity building of farmers and linking farmers to markets and credit facilities</li> <li>- Seed companies –marketing of the technologies</li> <li>- Traders/exporters – marketing of the technology</li> <li>- Processors - For value added products</li> <li>- Public institutions – schools (Providing of the market)</li> <li>- County governments –Help in the dissemination of the technology, Linking farmers to external markets</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos, Makueni, Kitui, Tharaka Nithi
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot
Challenges in dissemination	<ul style="list-style-type: none"> <li>- Limited seed systems hinder farmers from obtaining seed for new varieties</li> <li>- Unavailability of quality seed and high seed cost</li> <li>- Limited access to rural finance for pulse production</li> <li>- Limited processing technologies at the household level; mainly known for making stew served with cereal-based meals</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Need for information dissemination on- GAPs</li> <li>- Participation of stakeholders along the value chain in technology development and on-farm validation</li> <li>- Promoting awareness among farmers about the loss of varietal vigour associated with recycling of saved seed</li> <li>- Upscale innovations to reduce production costs</li> <li>- Develop value added products</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- Partnership is important in technology dissemination and adoption</li> <li>- Involvement of end-user in technology development process eliminates the problem of fitting the crop to both the target environments and users' preferences</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>- Counties need to enact favourable policies to regulate food standards and markets.</li> <li>- Re-establish linkage between green gram production and consumption and importance in the local diet</li> <li>- Contractual marketing is key enabler towards streamlining markets -side conditions guarantee consistent supply</li> <li>- Increase public private dialogue to agree on a model that will ensure compliance with international standards</li> </ul>



	- Provision of improved market information on volume, quality and supply consistency requirements
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Kshs. 13,000
Estimated returns	The gross margins under improved management were estimated at KES 19,858.80/ha
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> </ul>
Gender related opportunities	The technology can benefit men, women and the youth to generate income
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>- The crop is important for food and nutrition security there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> <li>- Due to the crop's importance for food and nutrition security, there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> <li>- Need for mechanization to ease drudgery at harvesting</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household.</li> <li>- It offers a good opportunity for income generation for both men and women</li> <li>- The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Samuel Mukosa, an early adopter who is now growing and selling to other farmers in Mbuvo, Makueni county
Application guidelines for users	Guidelines available in extension publications
<b>G: Contacts</b>	
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	<ul style="list-style-type: none"> <li>1-Ready for upscaling</li> <li>2-requires validation</li> </ul>
Contacts	The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0736333294
Lead organization and scientists	KALRO Rael Karimi (Katumani)
Partner organizations	<ul style="list-style-type: none"> <li>- World Vegetable Centre</li> <li>- MoALF&amp;I</li> <li>- Seed companies – Dryland seed ltd, East African Seed company</li> <li>- FAO</li> <li>- ICRISAT</li> </ul>

	<ul style="list-style-type: none"> <li>- KILIMO trust</li> <li>- East African Grain Council</li> </ul>
--	--

### GAPs for further research

5. Need for mechanization to ease the harvesting – Thresher
6. Explore bio-control of insect pests – white flies and aphids
7. Postharvest handling – protection against pests e. g rat-proof cages for protection of hermetic bags
8. Value added green gram based products – formulation of weaner diets

<b>2.1.2TIMP name</b>	Green gram variety KS 20
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields High demand for green grams
What is it? (TIMP description)	It is an early maturing (65 -75 days) high yielding (1500 kg/ha (8-9, 90 kg bags/acre) green gram variety that is tolerant to aphids, resistant to yellow mosaic and moderately resistant to powdery mildew. Its characteristic features include; cream pod colour when dry, large seed size (6 g/100 seeds), and dull green grains. Green gram grows in a wide range of climatic conditions. It is a low altitude, warm season crop and can be grown from sea level to 1600 m above sea level. The crop is also both heat and drought tolerant and thus can be grown in both semi-arid and well-watered areas. A warm humid climate with temperature ranging from 25-35 °C, 400-550 mm rainfall, well distributed during the growing period is suitable for cultivation. A well-drained loamy and sandy loam soil are best for its cultivation. The crop does not grow well in waterlogged soils.
Justification	ASALs are characterized by frequent droughts. Green grams is a short season legume and can fit into cropping patterns practiced in ASALs (two season cropping). Farmer available varieties are low yielding and late maturing. Conventional varieties, however have small pods and small seeds that are difficult to harvest. The small seed is undesirable in the market. This early maturing, high yield, pest and disease tolerant variety will increase yields and improve livelihoods. Due to their short growing cycle (65-75 days), green gram are considered less risk-prone. It is a nutritious warm season crop. The grain is abundant in protein, minerals and vitamins making it an ideal supplement to cereal-based diet which is the best solution to protein-calorie malnutrition. Its starch is easier to digest. It induces less flatulence and is well tolerated by children. Wide adoption of the improved varieties will

	play an important role in food security, balanced diet and alleviation of poverty.
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Seed companies and Agro-dealers</li> <li>- Traders/Exporters</li> <li>- Other research organizations/institutions (universities)</li> <li>- Processors</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>- Farmer participatory evaluation</li> <li>- On-farm demonstration</li> <li>- Field days</li> <li>- Agricultural shows</li> <li>- Farmer to farmer</li> <li>- Mass Media – Mkulima programme, Smart Farmer and Seeds of Gold</li> <li>- Promotional materials (posters/brochures/leaflets)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Need for good seed system to ensure accessibility</li> <li>- Strong linkage among green gram value chain actors – producers to market</li> <li>- Strong Partnership linkages</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- SIMLAW Seed Company to provide seed for the variety</li> <li>- Extension service providers (Public and private) to help in the technology dissemination</li> <li>- FAO facilitate in the promotion of the technology and linking farmers to market</li> <li>- Processors</li> <li>- County governments –Help in the dissemination of the technology, Linking farmers to external markets</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Meru, Machakos, Makueni, Kitui, Tharaka Nithi, Baringo
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>- Limited seed systems hinder farmers from obtaining seed for new varieties</li> <li>- Unavailability of quality seed and high seed cost</li> <li>- Limited access to rural finance for pulse production</li> <li>- Limited processing technologies at the household level; is mainly known for making stew served with cereal-based meals</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Need for information dissemination on GAPs</li> <li>- Participation of stakeholders along the value chain in technology development and on-farm validation</li> <li>- Promoting awareness among farmers about the loss of varietal vigour associated with recycling of saved seed</li> <li>- Upscale innovations to reduce production costs</li> <li>- Develop value added products – need to strengthen linkages between green gram production and consumption in local food systems (develop weaner diet)</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- Partnership is important in technology dissemination and adoption</li> </ul>

	<ul style="list-style-type: none"> <li>- Involvement of end-user in technology development process eliminates the problem of fitting the crop to both the target environments and users' preferences</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>- Re-establish linkage between green gram production and consumption -importance in the local diet</li> <li>- Use of contract management to guarantee consistent supply</li> <li>- Increase public-private dialogue to agree on a model that will ensure compliance with international standards</li> <li>- Provide market information on volume, quality and supply consistency requirements</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Kshs.13,000
Estimated returns	The gross margins under improved management were estimated at KES 19,858.80/ha
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> <li>- It offers a good opportunity for income generation for both men and women</li> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>- The technology can benefit men, women and the youth to generate income</li> </ul>
VMG issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>- The crop is important for food and nutrition security there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> <li>- Due to the crop's importance for food and nutrition security, there is therefore need to adopt affirmative action targeting the VMGs for dissemination, adoption and consumption</li> <li>- Need for mechanization to ease drudgery at harvesting</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>- As an early maturing and high yielding variety it will meet the food and nutrition security of the whole household.</li> <li>- It offers a good opportunity for income generation for both men and women</li> <li>- The crop is rich in protein and folate thus important in improving nutrition and health for the VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	
Application guidelines for users	
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation
<b>G: Contacts</b>	
Contacts	Simlaw seed Co. Ltd P.O Box 40024-00100 Nairobi Email: kariuki@simlaw.co.ke Phone:

Lead organization and scientists	Simlaw Seed Co. Ltd, Michael Ngugi and Thomas Kariuki
Partner organizations	County Governments

### GAPs for further research

1. Need for mechanization to ease the harvesting – Thresher
2. Explore bio-control of insect pests – white flies and aphids
3. Postharvest handling – protection against pests e. g rat-proof cages for protection of hermetic bags
4. Value added green gram based products – formulation of weaner diets

## 2.2 Integrated Pest Management

<b>2.2.1 TIMP name</b>	Integrated Pest Management of white flies
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield loss and low grain quality due to white fly damage
What is it? (TIMP description)	Integrated pest management (IPM) involves the combination of chemical, biological and cultural control methods Cultural control: Rotation of green gram with non-host crop (cereals) Biological: Use of predators, use yellow sticky traps at the rate of 10-12 traps/ha to trap. The white flies traps are hanged slightly above the canopy level Chemical: Use of insecticides
Justification	Pests are major constraint in green gram production causing significant grain losses. IPM is an environment friendly approach to pest management which will help alleviate yield losses due to pest infestation and damage.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers,</li> <li>- extension officers</li> <li>- Research organizations and universities</li> </ul>
Approaches used to be used in dissemination	<ul style="list-style-type: none"> <li>- Extension publications</li> <li>- On-farm demonstrations</li> <li>- Farmer field days</li> <li>- Farmer training</li> <li>- Agricultural shows and exhibitions</li> <li>- Farmer to farmer training</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Strong partnership linkages</li> <li>- Suitability of the TIMP to the agro climatic and socio-economic condition of the farmer e.g. Affordable mechanized tools will be easy to promoted (use of planter, oxen-drawn plough to make ridges)</li> <li>- Accessibility of the TIMP by the farmers</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private) to help in the dissemination</li> <li>- FAO to facilitate promotion</li> <li>- NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers</li> <li>- County governments –Help in the dissemination of the technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
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	<ul style="list-style-type: none"> <li>- More than one approach is used in management of insect (white fly)</li> <li>- IPM is environment friendly and the chemical component should be used as the last resort</li> <li>- Need for farmer involvement in helping 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) in control of both field and storage pests.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>- Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices</li> <li>- Training on IPM to increase awareness of IPM and reduce possible negative impact on the environment resulting from wrong application of IPM</li> <li>- Market able to absorb increased supply of grain</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Kshs. 13,000
Estimated returns	The gross margins under improved management were estimated at KES 19,858.80/ha
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- The management practice reduces the production costs therefore women can afford to produce the technology</li> <li>- IPM protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>- Opportunities for youth employment in implementing IPM protocols</li> <li>- Opportunities in marketing pest traps</li> </ul>

VMG issues and concerns in development and dissemination	The management practice reduces 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.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	Extension publications not yet developed
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation 3-requires further research
<b>G: Contacts</b>	
Contacts	The Center Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0736333294
Lead organization and scientists	KALRO-Katumani, Rael Karimi
Partner organizations	- Extension service providers (Public and private) - FAO - NGOs:

## 23 Integrated Disease Management

<b>2.3.1 TIMP name</b>	Integrated Disease Management
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield loss and low grain quality due to disease
What is it? (TIMP description)	Integrated disease management (IDM) involves the combination of chemical and cultural control methods

	Chemical: Use of fungicides Cultural control: Rotation of green gram with non-legume, field hygiene, use of clean seed
Justification	Diseases (Green gram yellow mosaic disease, bacterial blight, powdery mildew, and anthracnose) are major constraints in green gram production causing significant grain losses both in terms of quantity and quality. Majority of the diseases are seed-borne and therefore very common in areas where farmers recycle their own saved seed. IDM is an environmental friendly approach to disease management which will help alleviate yield losses due to disease damage.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Extension Agents (Public and Private)</li> <li>- Research organizations and universities</li> </ul>
Approaches used to be used in dissemination	<ul style="list-style-type: none"> <li>- Extension publications</li> <li>- On-farm demonstrations</li> <li>- Farmer field days</li> <li>- Farmer training</li> <li>- Agricultural shows and exhibitions</li> <li>- Farmer to farmer training</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Strong partnership linkages</li> <li>- 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.</li> <li>- Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private) to help in the dissemination</li> <li>- FAO to facilitate promotion</li> <li>- NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers</li> <li>- County governments –Help in the dissemination of the technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in dissemination	Farmers are not receptive to cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land holdings and limited economic resources. Majority of the diseases are seed borne ant thus use of recycled seed limits their control



Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation) in managing seed borne diseases
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- More than one approach is used in management of major diseases</li> <li>- IDM is environment friendly and the chemical component should be used as the last resort</li> <li>- 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</li> <li>- 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.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>- understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices</li> <li>- Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM</li> <li>- Market able to absorb increased supply of grain</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>- The management practice reduces the production costs and therefore women can afford to produce green grams</li> <li>- IDM protocols will not overburden any gender in implementation and are therefore has potential for adoption by both gender.</li> <li>- Setting of traps may create income generation opportunity for the youth</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>- Opportunities for youth employment in implementing IDM protocols</li> <li>- Opportunities in marketing pest traps</li> </ul>
VMG issues and concerns in development, dissemination adoption and scaling up	The management practice reduce the production costs therefore VMG's can afford to produce green grams
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories	-
Application guidelines for users	Extension publications not yet developed

<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0736333294
Lead organization and scientists	KALRO-Katumani, Nzioki C., and Rael Karimi
Partner organizations	<ul style="list-style-type: none"> <li>- Extension service providers</li> <li>- FAO</li> <li>- NGOs</li> <li>- County governments</li> <li>- Help in the dissemination of the technology,</li> </ul>

### Research Gaps:

1. Explore Bio-control option for pests and diseases

## 2.4 Fertility Management

<b>2.4.1 TIMP Name</b>	<b>Integrated soil fertility management (ISFM)</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Declining and low crop productivity due to declining soil fertility, water scarcity. Continuous cultivation with limited input use has greatly decreased the inherent soil fertility which is a fundamental impediment to agricultural growth and food production. Fertilizer tend to be expensive, unavailable and unaffordable for the smallholder farmers. Intercropping green gram and cereals provides farmers with alternatives to diversify their farming systems and improve soil fertility through nitrogen fixation.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizer, organic inputs, intercropping and rotations aiming at optimizing use efficiency of the applied nutrients and improving crop productivity

Justification	Reduced soil fertility as a result of soil degradation due to past management by farmers has a major negative influence on crop productivity. These challenges call for an integrated soil fertility management technology that combines appropriate interventions on soil management, fertilizer use and crop agronomy to drive the main outputs of increased yield and productivity.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>- Extension publications</li> <li>- On-farm demonstrations</li> <li>- Training workshops</li> <li>- Farmer field schools/farmer days</li> <li>- Farmer participatory evaluation</li> <li>- On-farm demonstration</li> <li>- Field days</li> <li>- Agricultural shows and exhibitions</li> <li>- Farmer to farmer</li> <li>- Mass Media – e.g. Mkulima programme, Smart Farmer and Seeds of Gold</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Availability of affordable and quality manure, fertilizers</li> <li>- Local adaptation of ISFM to account for variability between farms</li> <li>- Production resources available (i.e. land, access to financing, labour, crop residues and animal manures) that different farming families invest in the fields in their farm.</li> <li>- Availability of varieties that are compatible with associated crops</li> <li>- Effective multiplication and distribution of improved planting materials of these varieties</li> <li>- Document appropriate times of planting the intercrops, fertilizer rates and regimes</li> <li>- Provide appropriate planting patterns</li> <li>- Availability of appropriate machinery for key tasks such as planting, weeding fertilizing and harvesting.</li> <li>- Strong partnership linkages</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private – Capacity building on importance of ISFM on green gram production</li> <li>- County governments –Capacity building</li> <li>- Farmer groups – Providing farms for on-farm demonstrations</li> <li>- MoALF&amp;I –Extension services</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Machakos, Makueni, Kitui Tharaka Nithi, Meru, Machakos

Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>- Lack of locally tested and adapted ISFM technologies that are site specific and value chain based</li> <li>- High cost especially in areas where application of ISFM is non- responsive</li> <li>- Misconceptions that chemical fertilizer damage the soils</li> <li>- Lopsided customary beliefs that have pushed female gender &amp; youths to periphery regarding access and ownership of land for production.</li> <li>- Limited access to clean planting materials of these crops that are compatible with associated crops</li> <li>- Lack of site-specific value chain based manuals/extension material</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Develop site specific and value chain based ISFM technologies</li> <li>- Training and awareness creation on benefits of judicious fertilizer applications and to dispel false misconceptions</li> <li>- Gender friendly mechanization (Conservation Agriculture (CA) equipments) be integrated to scale CA adoption to beyond 10%</li> <li>- Innovation by Youth need to be captured and scaled up</li> <li>- Affordability of certified inputs –e.g. use of rippers</li> <li>- In conservation Agriculture there is competition between mulch for soil cover and feed for livestock</li> <li>- Letting loose livestock into ripped fields often leading to compaction</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>- Soil &amp;Water management works and is important in the marginal areas.</li> <li>- Low adoption is reported to be due to of lack of site specific and value chain based ISFM technologies and the technicalities involved in the whole process of the implementation</li> <li>- Crop rotation is a technology that is adopted widely. Adoption depends on: different farmer goals and objectives.</li> <li>- Limited skills especially on control of pest and diseases through intercropping. More awareness and training programs are required</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>- Socially acceptable by farmers and environment friendly</li> <li>- Increased yields will be absorbed by the markets</li> <li>- Increased supply will not lower prices</li> <li>- Enabling policy frameworks to support development and adoption of the management practice</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not done

Estimated returns	Not done
Gender issues and concerns in development, dissemination adoption and scaling up	The management practice increases productivity therefore both gender can benefit from the increased production
Gender related opportunities	Since the management practice increases productivity, both gender can benefit from the increased income
VMG issues and concerns in development, dissemination adoption and scaling up	- Through application of ISFM, VMG's can benefit from increased green gram production therefore raising their incomes
VMG related opportunities	The technology can improve food and nutrition security and a window for increased income.
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>- Reports from SIMLESA have shown that farmers have increased yield and reduced production risk by 30 %. For instance a farmer was able to increase yield from six 90 kg bags in one acre to 30-35 bags from the same one acre through use of CA- retaining crop residue and use of herbicides for weeding.</li> <li>- Youth integration into CA e.g. service provision and value addition has started bearing fruit in Makueni County and requires scaling up to capitalize on their numbers.</li> </ul>
Application guidelines for users	<p>Manual available</p> <p>The ISFM definition places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently i.e.</p> <ol style="list-style-type: none"> <li>1. Fertilizer banding: field application of fertilizer directly in area of root-zone to increase the potential for uptake</li> <li>2. Micro-dosing: applying small quantities of fertilizer to the seed at planting and a few weeks after emergence</li> </ol>
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	<p>1-Ready for upscaling</p> <p>2-Requires validation</p>
<b>G: Contacts</b>	
Contacts	Center Director, KALRO-Kabete Email: <a href="mailto:cd.kabete@kalro.org">cd.kabete@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma, P. Kitiem, J. Mwaura, A. Esilaba, J. Wamuongo, D. Kamau
Partner organizations	County department of agriculture

## 2.5 Agronomic practices

<b>2.5.1 TIMP name</b>	<b>Good Agronomic Practices -Spacing</b>
Category (i.e. technology, innovation or management practice)	Management practice

<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low productivity, drought due to poor crop husbandly (planting method, plant population)
What is it? (TIMP description)	Good Agronomic Practices are a set of management guidelines applicable to crop production, harvesting and storage. They range from seed selection, planting, crop management and harvesting
Justification	Low grain yield is attributed to poor cultivation techniques/agronomic management practices (poor spacing). Most of the farmers plant by broadcasting or drilling the seed which is never thinned making weeding, crop management and harvest more labour intensive and significantly reduce crop productivity and economic return. Use of recommended spacing is advantageous as it requires less seed, ensures optimum plant population, high yield and quality grain/seed. Controlling plant populations ensures optimum use of nutrients.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Research organizations and universities</li> <li>- Extension Agents (Public and Private)</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>- On-farm demonstrations,</li> <li>- Farmer field schools</li> <li>- Training in workshops</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Capacity building on the importance of GAPs</li> </ul>
Partners/stakeholders for scaling up	County government extension services, farmer groups
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Tharaka Nithi, Machakos
Counties where TIMPs will be up scaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>- Limited knowledge on importance of correct crop spacing</li> <li>- Lack of specific mechanised planters</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>- Information dissemination - GAPs</li> <li>- Participation of producers in on-farm activities/extension activities</li> <li>- Promoting awareness among farmers on the importance of Good Agronomic Practices for improved crop productivity</li> </ul>
Lessons learned in up scaling, if any	Alternative method (mechanization - planter) may lessen the work Capacity building and awareness campaign on GAPs are required
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>- Commodity is socially acceptable</li> <li>- Conducive environment for production of green grams</li> <li>- Ability of market to absorb increased productivity</li> <li>- Supporting frameworks and policies are available</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	To be determined
Estimated returns	To be determined

Gender issues and concerns in development, dissemination adoption and scaling up	The management practice is meant to increase the productivity therefore both gender can benefit from the increased production
Gender related opportunities	Since the management practice increases productivity, both gender can benefit from the increased income
VMG issues and concerns in development, dissemination adoption and scaling up	Application of the management practice will lead to increased green gram production and increased income
VMG related opportunities	The increased production will provide VMGs with better income, increased food and nutrition security
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	-
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Ready for upscaling Requires further research (testing for location specific spacing)
Application guidelines for users	Brochures available
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0736333294
Lead organization and scientists	KALRO, Njaimwe, A; E. Mutuma, P. Kitiem, J. Mwaura, A. Esilaba, J. Wamuongo, D. Kamau.
Partner organizations	County Governments

## 2.5 Soil and Moisture conservation

<b>2.5.1TIMP Name</b>	<b>Improved Tied Ridges</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	- Crop failure due to water scarcity/inadequate moisture/rainfall - Increased water losses in the furrows
What is it? (TIMP description)	Tied-ridges are soil and moisture conservation structures that involve the construction of small rectangular basins formed within the furrow of cultivated fields mainly to harvest and increase storage of rain water and allow more time for rainfall to infiltrate the soil. The stored water is used by the plants for a longer period of time better than it can be used in a situation of runoff. The Technology consist of water flowing down the small trenches/furrows running parallel and infiltrates into crop root zones.
Justification	Drought is the greatest abiotic constraint to increasing agricultural productivity in Kenyan ASALs hence

	threatening food security. The areas are characterized by low erratic rainfall (annual rainfall of 250-800 mm) which is uneven and poorly distributed leading to crop failure. The supplementation of water for crops during the dry spell becomes an obvious advantage. This supplementation can be made possible through successful water harvesting a technique of collecting and managing rainwater runoff to increase water availability for agricultural use through use of improved water harvesting techniques. Tied-ridges techniques increases soil moisture and plant growth when there is inadequate rainfall thus enhancing household food security, incomes and livelihoods.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>- Farmers</li> <li>- Extension Service Providers (Private and Public)</li> <li>- Researchers</li> </ul>
Approaches used in dissemination	<ul style="list-style-type: none"> <li>- Farmer participatory evaluation</li> <li>- Field demonstration</li> <li>- Field days</li> <li>- Agricultural shows</li> <li>- Farmer to farmer</li> <li>- Mass Media – e.g. Mkulima programme, Smart Farmer and Seeds of Gold</li> <li>- Extension publications (posters/ brochures/leaflets)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>- Water source and mainly areas close to permanent rivers,</li> <li>- Topography of area (level land)</li> <li>- Capacity for maintenance</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>- Extension service providers (Public and private – Capacity building on importance of ISFM on green gram production</li> <li>- County governments –Capacity building</li> <li>- Farmer groups – Providing farms for on-farm demonstrations</li> <li>- MoALF&amp;I –Extension services</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Presently practiced by farmers living along sites with sufficient water resource such Tana River (Galana), Baringo (Pekerra) etc.
Counties where TIMPs will be upscaled	Isiolo, Machakos, Taita Taveta, Tharaka Nithi, West Pokot, Baringo, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>- Can be Labour intensive during establishment phase</li> <li>- Poor management may lead to water inefficiencies</li> </ul>
Recommendations for addressing the challenges	Capacity building and awareness creation among target farmers on benefits of the technology
Lessons learned	<ul style="list-style-type: none"> <li>- Furrow irrigation significantly increases yields</li> <li>- Poor management and designs may often result in flooding of low areas</li> <li>- Assessment of soil erosion and sediment is key to successful commercial production</li> </ul>



	<ul style="list-style-type: none"> <li>- Increased yield can be achieved through use of tied ridges in ASALs</li> <li>- Adoption of the techniques is influenced by the socio-economic factors</li> <li>- Labour availability influence the adoption of water harvesting techniques.</li> <li>- Water harvesting leads to better crop yield, increasing household food security and enabling households to generate greater income</li> </ul>
Social, environmental, policy and market conditions necessary for development and upscaling	<ul style="list-style-type: none"> <li>- Women get opportunities to improve the production, as they are responsible for agricultural activities and water supply.</li> <li>- The technology reduces/ameliorates the degradation of environment by farming activities and weather (rainfall)</li> <li>- Environmentally, no significant adverse impacts linked to this technology.</li> <li>- Enabling policies and guidelines regarding water abstraction from the main river to minimize resource conflicts especially along river downstream.</li> <li>- Market for the crops produced under irrigation is available and can absorb the increased produce</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	- The main costs are related to building furrows.
Estimated returns	- Farmers significantly increase yields stemming from management of crop water stress
Gender issues and concerns in development, dissemination adoption and scaling up	Improved Tied Ridges increases crop production and therefore both gender can benefit from the increased income
Gender related opportunities	The technology is meant to increase the productivity therefore both gender can benefit from the increased household income
VMG issues and concerns in development, dissemination adoption and scaling up	The technology is aimed increasing production and therefore providing food and nutrition security and a window for increased income.
VMG related opportunities	The increased production will provide VMGs with better income, increased food and nutrition security
<b>E: Case studies/profiles of success stories</b>	
Success stories	There are successful model for such technology i.e. Mwea and Pekerra irrigation schemes where furrow irrigation systems have provided opportunities for local community to produce high value crops. A sound understanding of the roles and responsibilities of farmers and water user associations is a feature of successful system.
Application guidelines for users	Guidelines (manuals) available at KALRO-Katumani
<b>F: Status of TIMP readiness</b> (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling
<b>G: Contacts</b>	

Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0736333294
Lead organization and scientists	KALRO; Gichangi E. P. Ketiemi, E. Mutuma, J. Mwaura, A. Esilaba, J. Wamuongo, D. Kamau, I. Sijali
Partner organizations	National Irrigation Board (NIB), Water Resources Management Authority

**Research Gaps:**

1. Studies on green gram cropping patterns in intercropping systems for optimal production