



# Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Garden Pea Value Chain



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## **DISCLAIMER**

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

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## **FOREWORD**

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

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

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

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

## **PREFACE**

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

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

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

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

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

Francis Muthami

**National Project Coordinator**

**Kenya Climate-Smart Agriculture Project**

## Table of Contents

<b>DISCLAIMER.....</b>	<b>i</b>
<b>FOREWORD.....</b>	<b>ii</b>
<b>PREFACE.....</b>	<b>iii</b>
<b>ABBREVIATIONS AND ACRONYMS.....</b>	<b>vi</b>
<b>1.0 INTRODUCTION.....</b>	<b>7</b>
1.1 BACKGROUND INFORMATION .....	7
1.2 DEFINITION OF TERMS.....	7
1.3 SUMMARY OF INVENTORY OF TIMPS IN THE GARDEN PEA VALUE CHAIN.....	7
<b>2.0 DETAILED GARDEN PEAS VALUE CHAIN TIMPS .....</b>	<b>13</b>
2.1 IMPROVED VARIETIES .....	14
2.2 SEED SYSTEMS.....	32
2.3 GOOD AGRICULTURAL PRACTICES AND FOOD SAFETY MANAGEMENT SYSTEM....	34
2.4 AGRONOMIC MANAGEMENT PRACTICES.....	41
2.5 SOIL FERTILITY MANAGEMENT AND WATER CONSERVATION .....	49
2.6 GARDEN PEA CROP HEALTH.....	74
2.7 POSTHARVEST HANDLING .....	190
2.8 VALUE ADDITION .....	203
2.9 MECHANIZATION OF GARDEN PEA PRODUCTION ACTIVITIES .....	206
2.10 GARDEN PEA FARMING BUSINESS AND MARKETING.....	7
2.11 AGRICULTURAL POLICY OPTIONS .....	27

## **ABBREVIATIONS AND ACRONYMS**

AEZ	Agro-ecological zone
ASALs	Arid and Semi-Arid Lands
B	Boron
CA	Conservation Agriculture
CCPs	Critical control points
CIGs	Common Interest Group
CLs	Critical limits
CC	Climate Change
CSA	Climate Smart Agriculture
FFBS	Farmer Field and Business School
FSMS	Food Safety Management System
GAPs	Good Agricultural Practices
ha	Hectare
HACCP	Hazard Analysis Critical Control Points
HCD	Horticulture Crop Directorate
IDM	Integrated Disease Management
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility management
IWM	Integrated Weed Management
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Project
kg	Kilogram
TIMPs	Technologies, Innovations and Management Practices
ToT	Training of Trainers
VMG	Vulnerable and Marginalized Groups
SWOT	Strengths Weaknesses Opportunities and Threats
NGO	Non-Governmental Organizations
CIDP	County Integrated Development Plan
NARI	National Agricultural Research Institutions
IFPRI	The International Food Policy Research Institute
GHG	Green House Gases
IMM	Integrated Manure Management
CBO	Community Based Organization
AVRDC	World Vegetable Centre
KES	Kenya Shillings
KEPHIS	Kenya Plant Health Inspectorate Services
MoALF&I	Ministry of Agriculture Livestock Fisheries and Irrigation
AFA	Agriculture and Food Authority
STAK	Straders Association of Kenya
KFC	Kenya Flower Council
CoG	Council of Governors
GMP	Good Manufacturing Processes
GPS	Global Positioning System
WP	Wettable Powder
PCPB	Pest Control Products Board

## **1.0 INTRODUCTION**

### **1.1 BACKGROUND INFORMATION**

The Kenya Climate Smart Agriculture Project (KCSAP) is a Government of Kenya/World Bank supported project under the State Department for Crops Development in the Ministry of Agriculture, Livestock, Fisheries and Irrigation (MoALF&I). The Project Development Objective (PDO) is "to increase agricultural productivity and build resilience to climate change risks in targeted smallholder farming and pastoral communities in Kenya, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response". This objective will be achieved through utilization of climate-smart agriculture (CSA) technologies, innovations and management practices (TIMPs). Natural Resource Management technologies, innovations and management practices are critical in achieving food security under a changing climate while delivering co-benefits for environmental sustainability, nutrition and livelihoods.

The KCSAP Project aims to inventorize all CSA TIMPs in the Natural Resource Management and Bio-energy. The overall goal is three pronged: (i) Improve efficiency in the use of natural resources for increased food production; (ii) Maintain the resilience of agricultural systems and the dependent communities, and (iii) reduce GHG emissions per unit of output.

### **1.2 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)

### **1.3 SUMMARY OF INVENTORY OF TIMPS IN THE GARDEN PEA VALUE CHAIN**

The inventory process identified 69 TIMPs comprising 20 technologies, 3 innovations and 46 management practices, distributed among the 11 sub-themes, as indicated in the table

**Table 1: Summary of Garden Pea TIMPs**

<b>Commodity/VC</b>	<b>Sub-Theme</b>	<b>Technologies</b>	<b>Innovations</b>	<b>Management Practices</b>
Garden Pea	Improved garden pea varieties	5	0	0
Garden Pea	Garden Pea seed system	1	0	0
Garden Pea	Good agricultural Practices and food safety	0	0	2
Garden Pea	Agronomic management practices	0	0	3
Garden Pea	Soil Fertility and water Management	3	1	5
Garden Pea	Garden pea Crop health	2	0	23
Garden Pea	Postharvest management	3	1	1
Garden Pea	Garden Pea Value addition	1	0	0
Garden Pea	Mechanization of Garden Pea production activities	5	1	0
Garden Pea	Garden Pea business and Marketing	0	0	8
Garden Pea	Garden National policy	0	0	4
<b>Total</b>		<b>20</b>	<b>3</b>	<b>46</b>

**1.4 SUMMARY OF STATUS OF TIMPs IN GARDEN PEA VALUE CHAIN**

The inventory process resulted in a total of 29 TIMPs of which that are ready for up-scaling, 35 TIMPs that require validation and 5 TIMPs that require further research in the sub-themes, as indicated in Table 2.

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

<b>Commodity/VC</b>	<b>Sub-Theme</b>	<b>Ready for up-scaling</b>	<b>Require validation</b>	<b>Further Research</b>
Garden Pea	Improved Garden Pea Varieties	5	0	0
Garden Pea	Garden Pea seed system	0	0	1
Garden Pea	Good Agricultural Practices (GAP) and food safety	2	0	0
Garden Pea	Agronomic management practices	2	1	0
Garden Pea	Soil Fertility and water Management	7	2	0

Garden Pea	Garden Pea Crop health	22	1	2
Garden Pea	Postharvest management	1	4	0
Garden Pea	Garden Pea Value addition	1	0	0
Garden Pea	Mechanization of Garden Pea production activities	3	1	2
Garden Pea	Garden Pea business and Marketing	1	7	0
Garden	Policy	3	1	0
<b>Overall Total</b>		<b>29</b>	<b>35</b>	<b>5</b>

**Table 3: Inventory of Garden Pea TIMPs by Category and Status**

<b>TIMPs Sub-Theme</b>	<b>TIMPs Title</b>	<b>TIMPs Category</b>	<b>Status</b>
<b>2.1 Improved Garden Pea varieties</b>	2.1.1.Garden Pea variety Green Feast	Technology	Ready for up-scaling
	2.1.2.Garden Pea variety Alderman	Technology	Ready for up-scaling
	2.1.3.Garden Pea variety Sommerwood	Technology	Ready for up-scaling
	2.1.4.Garden Pea variety Ambassador	Technology	Ready for up-scaling
	2.1.5 Garden Pea variety Earli Crop	Technology	Ready for up-scaling
<b>2.2 Garden Pea seed system</b>	2.2.1 Garden Pea seed Production	Technology	Requires more research and setting up
<b>2.3 Good Agricultural Practices and Food Safety</b>	2.3.1 Good Agricultural Practices	Management practice	Ready for up scaling
	2.3 .2.Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Garden Peas in Kenya	Management Practice	Ready for Up scaling
<b>2.4 Agronomic management practices</b>	2.4.1.Adopting row planting	Management practice	Ready for Up scaling
	2.4.2. Intercropping and rotation	Management practice	Requires validation
	2.4.3. Crop training (Staking and trellising)	Management practice	Ready for up scaling
<b>2.5 Soil fertility and water management</b>	2.5.1 Rapid soil testing	innovation	Requires validation
	2.5.2. Garden Pea Nutrition Management	Management Practice	Ready for upscaling

	2.5.3. Integrated Manure Management	Management Practice	Ready for Up scaling
	2.5.4 Drip Irrigation in pea production	Management Practice	Ready for Upscaling
	2.5.5. Integrated soil fertility management	Complementary management	Requires management
	2.5.6 Conservation Agriculture	Management practice	Ready for upscaling
	2.5.7 Bench Terraces	Management Practice	Ready for upscaling
	2.5.8 Fanya Juu	Management Practice	Ready for upscaling
	2.5.9 Grass strips	Management Practice	Ready for upscaling
<b>2.6 Garden Pea Crop Health (Pests)</b>	2.6.1 Management of pod borer <i>Etiella zinckenella</i> ( <i>Maruca vitrata</i> )	Management Practice	Requires validation
	2.6.2 Management of Thrips ( <i>Thrips tabaci</i> , <i>Frankliniella occidentalis</i> , <i>F. schultzeii</i> and <i>Ceratohripoides brunneus</i> )	Management Practice	Ready for upscaling
	2.6.3 Management of Pea aphid ( <i>Acyrtosiphon pisum</i> )	Management Practice	Ready for upscaling
	2.6.4 Management of leaf miners ( <i>Lyriomyza spp</i> )	Management Practice	Ready for upscaling
	2.6.5 Mexican bean beetle ( <i>Epilachina varivestis</i> )	Management Practice	Ready for upscaling
	2.6.5 Management of Red spider mites, <i>Tetranychus spp.</i>	Management Practice	Ready for upscaling
<b>Nematodes</b>	2.6.7 Rot knot nematodes ( <i>Moloidogyne spp</i> )	Management Practice	Ready for upscaling
<b>Diseases</b>	2.6.8 Pea wilt ( <i>Fusarium oxysporum f sp pici</i> )	Management Practice	Ready for upscaling
	2.6.9 Downy mildew ( <i>Peronospora viciae</i> )	Management Practice	Ready for upscaling
	2.6.10 Leaf and pod spots ( <i>Ascochyta</i> disease)	Management Practice	Ready for upscaling
	2.6.11 Botrytis, or grey mould ( <i>Botrytis cinerea</i> )	Management Practice	Ready for upscaling
	2.6.12 Powdery mildew ( <i>Erysiphe pisi</i> )	Management Practice	Ready for upscaling
	2.6.13 Foot and root rots ( <i>Fusarium solani f. sp. pisi</i> , <i>Phoma medicaginis var. pinodella</i> )	Management Practice	Ready for upscaling

	2.6.14 Management of Sclerotinia, or white mould ( <i>Sclerotinia sclerotiorum</i> )	Management Practice	Ready for upscaling
	2.6.15 Management of Rhizoctonia seedling blight ( <i>Rhizoctonia solani</i> )	Management Practice	Ready for upscaling
	2.6.16 Management of Septoria blotch ( <i>Septoria pisi</i> )	Management Practice	Ready for upscaling
	2.6.17 Management of Bacterial blight <i>Pseudomonas syringae</i> pv. <i>pisii</i> )	Management Practice	Ready for upscaling
	2.6.18 Management of viral diseases: 1. Enation mosaic Virus Pea enation mosaic virus (PEMV) 2. Red clover vein mosaic virus (RCVMV) 3. Pea streak virus (PSV)	Management Practice	Ready for upscaling
<b>Garden Peas Weed Management</b>	2.6.19. Integrated Weed Management	Management Practice	Ready for Upscaling
	2.6.20 Intercropping System with garden pea	Management Practice	Ready for Upscaling
	2.6.21. Chemical weed Control	Management Practice	Ready for Upscaling
	2.6.22. Mechanical weed control	Management Practice	Ready for Upscaling
	2.6.23. Bed Solalization for weed control	Technology	Requires further research
	2.6.24 Stale bed for weed control	Technology	Requires further research
	2.6.25 Safe use of herbicides	Management Practice	Ready for upscaling
<b>2.7 Garden Pea Post-harvest management</b>	2.7.1 Sorting and Grading of Garden Peas	Management Practice	Ready for Upscaling
	2.7.2.Zero Energy Brick Cooler	Innovation	Ready for Upscaling
	2.7.3. CoolBot™	Technology	Ready for Upscaling
	2.7.4. Wakati™ technology	Technology	Requires further Research
	2.7.5. Modified Atmosphere Packaging of Garden Peas (Ziploc® and Xtend® bag packaging)	Technology	Ready for Upscaling

<b>2.8 Garden Value Addition</b>	TIMP Name Solar drying of ALVs •Cabinet solar dryer /chimney solar dryer •Greenhouse solar dryer • DeHytray	Technology	Ready for Upscaling
<b>2.9 Mechanization of Garden Pea activities</b>	2.9.1.1 Power tiller	Technology	Requires Validation
	2.9.2. Garden pea Plough	Innovations	Requires further research
	2,9.2 Tine Harrow	Technology	Requires further research
	2,9,4 Garden pea Planter	Technology	Ready for Up scaling
	2.9.5 motorized Weeder	Technology	Ready for Up scaling
	2.9.6 Motorized Sprayer	Technology	Ready for up scaling
<b>2.10 Garden Pea business and Marketing (Marketing practices)</b>	2.10.1 Transformative model of garden pea production	Management practice	Requires Validation
	2.10.2 Profitability Analysis	Management practice	Ready for upscaling
	2.10.3 Market Research	Management practice	Requires validation
	2.10. 4 Collective marketing	Management practice	Requires validation
	2.10.5 Market innovation model	Management practice	Requires validation
	2.10.6 Contracted production model	Management practice	Requires validation
	2.10. 7. Internet/mobile marketing	Management practice	Requires validation
	2.10.8. Building a business plan for garden pea production	Management practice	Requires validation
<b>2.11 National agricultural strategies and policy options</b>	2.11.1 National agricultural policy strategies frame work for Garden pea production and marketing	Management practice	Ready for upscaling
	2.11.2. Policy circle	Management practice	Requires validation
	2.11.3 County integrated development planning	Management practice	Ready for upscaling
	2.11.4 Policy instruments related to Garden pea	Management practice	Ready for upscaling
	<b>Total TIMPS</b>	<b>69</b>	

## 2.0 DETAILED GARDEN PEAS VALUE CHAIN TIMPS

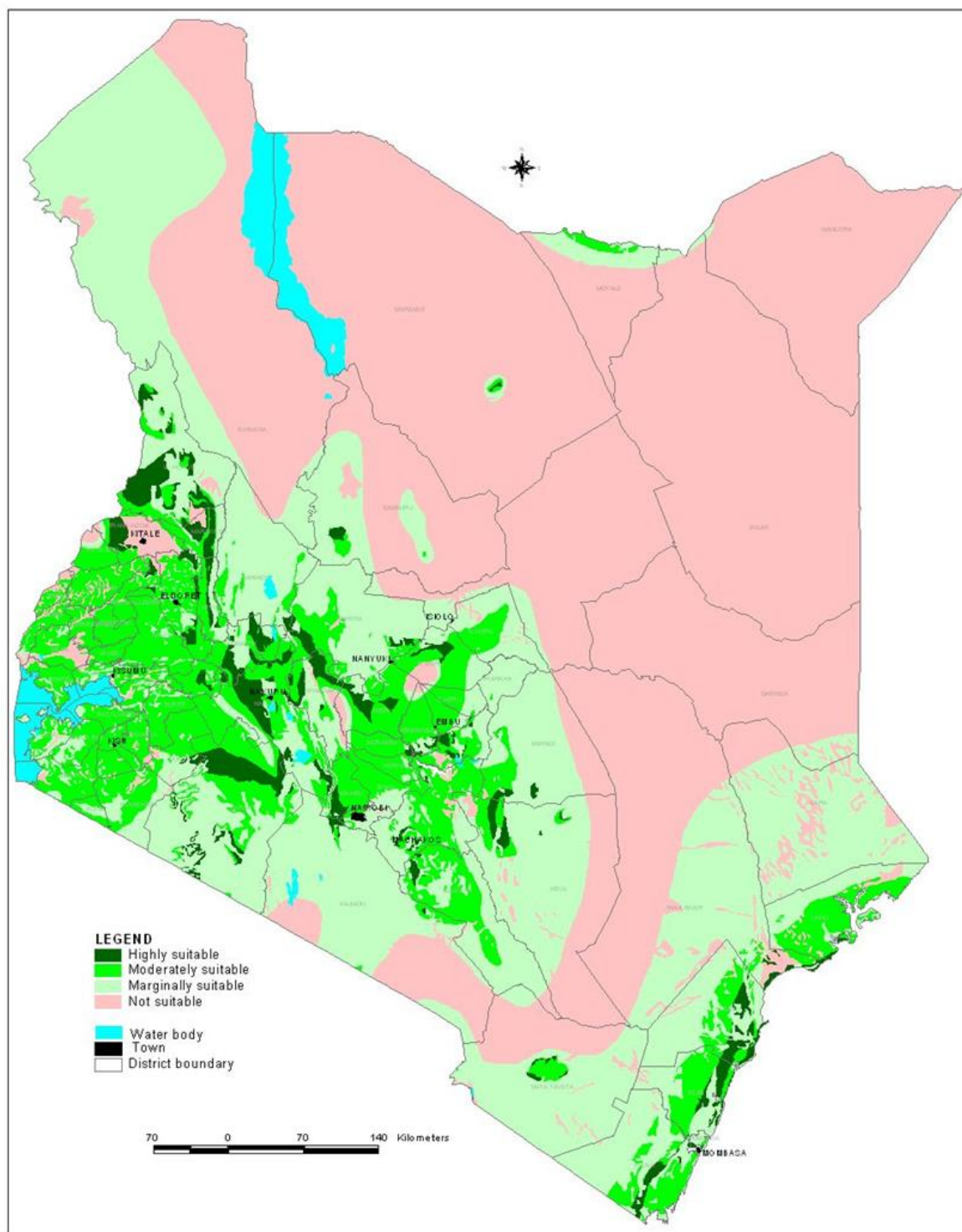




Figure 1: Garden Peas Suitability map of Kenya


## 2.1 IMPROVED VARIETIES

<b>2.1.1 TIMP Name</b> 	<b>Green Feast</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Garden pea production is characterized by low yields (3-5 bags/acre) because of low adoption of improved varieties. The crop is grown by smallholder farmers who attach low commercialization to it. Its consumption is restricted to use of the green pea with little value addition.
What is it? (TIMP description) 	Green feast variety, largely consumed in green form and is grown mainly for local fresh market and export. It is sweet flavored variety with good cooking qualities. The variety is a popular climbing, vigorous, heavy bearing, produces, large well-filled uniform pods, and sweet peas with long shelf life, suitable for freezing. It is a very early maturing 68 days with a yield potential 5-6 ton/ha.
Justification	Garden peas are amongst the most important legumes grown in the highlands of Kenya. Peas perform well in the altitudes above 1800 meters above sea level with well distributed rainfall during the growing period. It is a product of huge commercial interest for both local and export market able to yield 5 to 6t/ha.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Traders, Extension service, Processors (canning), Seed dealers, Researchers
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations (field days, exhibitions)</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Awareness creation by marketers and processors/farmer contracting</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Partners (Private Companies, NGOs)</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programmes</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> <li>• Agricultural Innovation Platforms</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Good Marketing Models and path ways</li> <li>• Certified Seed availability and accessibility</li> <li>• Good seed system to ensure quality the market demands</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, and International research organizations e.g. AVRDC to provide variety, seed and production information</li> <li>• Market agents and Stockists to create markets and delivery pathways</li> <li>• Farmers/farmer groups to produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Seed companies for quality seed multiplication, e.g. Kenya Seed Company</li> <li>• Financial institutions e.g. Banks and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Narok, Nakuru
Counties where TIMP will be up scaled	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Tranzoia, Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Labour intensity in planting, weeding, harvesting and threshing</li> <li>• Unorganized marketing channels</li> <li>• Weak seed systems leading to mixing and below potential yields and poor quality ponds and seeds.</li> <li>• Inadequate certified seeds</li> <li>• Lack of seed multipliers and distributors in the new interested counties</li> <li>• The enterprise of marketing the ponds is controlled by middlemen who exploit the farmers</li> <li>• Limited processing technologies and consumption diversity at the household level</li> <li>• The varieties are not adapted to warm and dry areas leading to low yields in those areas</li> <li>• Inappropriate of production practices</li> <li>• Diseases and pests control measures</li> <li>• The crop is highly perishable and hence the need to develop hands-on handling practices for farm to market</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Initiation of large-scale production where mechanization can be employed</li> <li>• Training on seed production systems</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote marketing models that encourage collective production and marketing</li> <li>• Involve County governments, extension, marketers and processors</li> <li>• Decentralize seed distribution in the target areas and engage County governments in seed distribution to enhance ease of accessibility</li> <li>• Training of households on alternative use and cottage-based processing</li> <li>• Develop varietal lines adapted for the warmer lines</li> <li>• Training growers on good agricultural production practices</li> <li>• Training of producers on good disease and pest control practices</li> <li>• Development and dissemination of good post-harvest practices</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• The demand for garden peas is high and hence the need to upscale production in other suitable areas to satisfy the demand</li> <li>• Farmers need persistent hands-on training in proper agronomic practices, Marketing and value addition for proper impact</li> <li>• Perishability of the crop demands proper handling from farm to market</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on nutritive and commercial importance of the variety.</li> <li>• Harmonious gender consideration in research, consumption and marketing. It is cultivated mainly by women hence the need to capacity build them.</li> <li>• Enabling policy and policy review from time to time</li> <li>• Value addition needs enhancement to develop further the canning industry</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 120,000 per acre
Estimated returns	KES 380,000 per acre. Returns =260,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for garden pea's cultivation than men.</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as seeds than men.</li> <li>• Women have limited access to markets than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities exist for women and youths to acquire the required credit</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for garden pea’s cultivation than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• VMGs have limited access to education, training and extension services than men.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by the VMGs due to lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities exist for VMGs to acquire the required credit.</li> <li>• Increased production will lead to increased consumption and utilization of garden peas and hence improved health of VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Farmers have benefited with the crop in Molo Nakuru, Nyandarua, Nyeri, Meru, Kirinyaga, Bomet and other counties</li> </ul>
Application guidelines for users	<b>Reference:</b> <ul style="list-style-type: none"> <li>• Garden pea production manual</li> <li>• Garden pea leaflets.</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	1. Ready for up-scaling
<b>G. Contacts</b>	
Contacts	The Centre Director, KALRO-PTC Thika; P.O. Box 220 Thika Email: <a href="mailto:kalro.ptc@kalro.org">kalro.ptc@kalro.org</a>
Lead organization and scientists	KALRO Antony Nyaga, Robert Musyoki, Eliud Gatambia, Ceaser Kambo and Sylvia Kuria
Partner organizations	Kenya seed Company and other seed merchants, Agricultural University Colleges, MoALF, NGO’s


<b>2.1.2 TIMP Name</b>	<b>Alderman</b>
	

Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	The low production (3-5 bags/acre) of Garden peas because of low adoption of improved varieties. Grown by smallholder farmers who attach low commercialization to it. The crop's consumption is restricted to use of the green pea with little value addition.
What is it? (TIMP description)	Alderman variety is climbing variety requiring support and with high production. It produces large pods with big peas and has long harvest period. It matures in 74 days and can yield up to 4-6 tons/ha.
Justification	The variety has moderate maturity period and a long harvest period which compensates for the extra care it requires for trellising and stacking. The long harvesting period increases yields of 4-6 tons/ha
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Traders, Processors (canning), Seed dealers, Researchers, Extension service.</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Training workshops, seminars, meetings</li> <li>• Awareness creation by marketers and processors/farmer contracting</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programmes</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> <li>• Agricultural Innovation Platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Good Marketing Models and path ways</li> <li>• Certified Seed availability and accessibility</li> <li>• Good seed system to ensure quality</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to adapt to new areas</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, International research organizations e.g. AVRDC to provide variety, seed and production information</li> <li>• Market agents and Stockist to create markets and delivery pathways</li> <li>• Farmers/farmer groups to produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Seed companies for quality seed multiplication</li> <li>• Financial institutions e.g. Banks and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru
Counties where TIMP will be up scaled	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Tranzoia, Uasin Gishu
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Labour intensity in planting, weeding, harvesting and threshing</li> <li>• Unorganized marketing channels</li> <li>• Weak seed systems leading to mixing and below potential yields and poor quality ponds and seeds.</li> <li>• Inadequate certified seeds</li> <li>• Lack of seed multipliers and distributors in the new interested Counties</li> <li>• The enterprise of marketing the ponds is controlled by middlemen who exploit the farmers</li> <li>• Limited processing technologies and consumption diversity at the household level</li> <li>• The variety is not adapted to warm and dry areas leading to low yields in those areas</li> <li>• Inappropriate of production practices</li> <li>• Diseases and pests control measures</li> <li>• The crop is highly perishable and hence the need to develop hands on handling practices for farm to market</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Initiation of large-scale production where mechanization can be employed</li> <li>• Training on seed production systems</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote marketing models that encourage collective production and marketing</li> <li>• Involve County governments, extension, marketers and processors</li> <li>• Decentralize seed distribution in the target areas and engage County governments in seed distribution to enhance ease of accessibility</li> <li>• Training of households on alternative use and cottage-based processing</li> <li>• Develop varietal lines adapted for the warmer lines</li> <li>• Training growers on good agricultural production practices</li> <li>• Training of producers on good disease and pest control practices</li> <li>• Development and dissemination of good post-harvest practices</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• The demand for garden peas is high and hence the need to upscale production in other suitable areas to satisfy the demand</li> <li>• Farmers need persistent hands-on training in proper agronomic practices, Marketing and value addition for proper impact</li> <li>• Perishability of the crop demands proper handling from farm to market</li> </ul>

Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on nutritive and commercial importance of the variety.</li> <li>• Harmonious gender consideration in research, consumption and marketing. It is cultivated mainly by women hence the need to capacity build them.</li> <li>• Enabling policy and policy review from time to time</li> <li>• Value addition needs enhancement to develop further the canning industry</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 120,000
Estimated returns	KES 380,000 per acre. Returns =KES 260,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for garden pea's cultivation than men.</li> <li>• Women and youth may also have limited access to finances to buy the required inputs such as seeds than men.</li> <li>• Women have limited access to markets than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities exist for women and youths to acquire the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for garden pea's cultivation than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• VMGs have limited access to education, training and extension services than men.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by the VMGs due to lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities exist for VMGs to acquire the required credit.</li> <li>• Increased production will lead to increased consumption and utilization of garden peas and hence improved health of VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Farmers have benefited with the crop in Molo Nakuru, Nyandarua, Nyeri, Meru, Kirinyaga, Bomet and other counties</li> </ul>
Application guidelines for users	<b>Reference:</b> Extension Materials, Handouts, Garden brochures
<b>F: Status of TIMP readiness</b> (1-ready for upscaling, 2-requires validation; 3-requires further research)	2. Ready for up-scaling
<b>G. Contacts</b>	

Contacts	The Centre Director, KALRO-PTC Thika; CD KALRO Sericulture, CD KALRO Kandara P.O. Box 220 Thika Email: <a href="mailto:kalro.ptc@kalro.org">kalro.ptc@kalro.org</a>
Lead organization and scientists	KALRO Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo and Sylvia Kuria
Partner organizations	Kenya seed Company and other seed merchants, Agricultural University Colleges, MoALF, NGO's


<b>2.1.3 TIMP Name</b>	<b>Sommerwood</b>
	
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	The low production (3-5 bags/acre) of Garden peas because of low adoption of improved varieties. The crop is grown by smallholder farmers who attach low commercialization to it. Its consumption is restricted to use of the green pea with little value addition.
What is it? (TIMP description)	Sommerwood variety is excellent stress tolerance with large, straight, medium green pods and maturing in 75 days. The variety has a potential yield range of 3 to 6 t/ha depending management
Justification	The variety performs well in the altitudes above 1800 meters above sea level with well distributed rainfall during the growing period. It is a product of huge commercial interest for both local and export market. The variety's yield potential ranges from 3 to 6 t/ha
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>Farmers, Traders, Processors (canning), Seed dealers, Researchers, Extension service.</li> </ul>

Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Awareness creation by marketers and processors/farmer contracting</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Partners (Private Companies, NGOs)</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> <li>• Agricultural Innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Good Marketing Models and path ways</li> <li>• Certified Seed availability and accessibility</li> <li>• Good seed system to ensure quality</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to adapt to new areas</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. AVRDC to provide variety, seed and production information</li> <li>• Market agents and stockists to create markets and delivery pathways</li> <li>• Farmers/farmer groups to produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Seed companies for quality seed multiplication</li> <li>• Financial institutions e.g. Banks and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Bomet, Kericho
Counties where TIMP will be up scaled	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Tranzoia, Uasin Gishu, Bomet, Kericho

Challenges in dissemination	<ul style="list-style-type: none"> <li>• Labour intensity in planting, weeding, harvesting and threshing</li> <li>• Unorganized marketing channels</li> <li>• Weak seed systems leading to mixing and below potential yields and poor quality ponds and seeds.</li> <li>• Inadequate certified seeds</li> <li>• Lack of seed multipliers and distributors in the new interested Counties</li> <li>• The enterprise of marketing the ponds is controlled by middlemen who exploit the farmers</li> <li>• Limited processing technologies and consumption diversity at the household level</li> <li>• The variety is not adapted to warm and dry areas leading to low yields in those areas</li> <li>• Inappropriate of production practices</li> <li>• Diseases and pests control measures</li> <li>• The crop is highly perishable and hence the need to develop hands on handling practices for farm to market</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Initiation of large-scale production where mechanization can be employed</li> <li>• Training on seed production systems</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote marketing models that encourage collective production and marketing</li> <li>• Involve County governments, extension, marketers and processors</li> <li>• Decentralize seed distribution in the target areas and engage County governments in seed distribution to enhance ease of accessibility</li> <li>• Training of households on alternative use and cottage-based processing</li> <li>• Develop varietal lines adapted for the warmer lines</li> <li>• Training growers on good agricultural production practices</li> <li>• Training of producers on good disease and pest control practices</li> <li>• Development and dissemination of good post-harvest practices</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• The demand for garden peas is high and hence the need to upscale production in other suitable areas to satisfy the demand</li> <li>• Farmers need persistent hands on training in proper agronomic practices, Marketing and value addition for proper impact</li> <li>• Perishability of the crop demands proper handling from farm to market</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on nutritive and commercial importance of the variety.</li> <li>• Harmonious gender consideration in research, consumption and marketing. It is cultivated mainly by women hence the need to capacity build them.</li> <li>• Enabling policy and policy review from time to time</li> </ul>

	<ul style="list-style-type: none"> <li>Value addition needs enhancement to develop further the canning industry</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 120,000per acre
Estimated returns	KES 380,000 per acre. Returns =KES 260,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>Women and youth have limited access to education, training and extension services than men</li> <li>Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>Women have less access to agricultural information, technology and knowledge</li> <li>There is low adoption by VMGs due lack of awareness</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Opportunities for youths and women exists peas production, value addition and marketing</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>VMGs have limited access to training and extension services</li> <li>VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>VMGs have limited access to seed and information on new varieties and production techniques</li> <li>There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities for VMG youths and women exists in peas production and value addition</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>Farmers have benefited with the crop in Molo Nakuru, Nyandarua, Nyeri, Meru, Kirinyaga, Bomet and other counties</li> </ul>
Application guidelines for users	<b>Reference:</b> Extension Materials, Handouts
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	3. Ready for up-scaling
<b>G. Contacts</b>	
Contacts	The Centre Director, KALRO-PTC Thika; KALRO Sericulture, KALRO Kandara P.O. Box 220 Thika Email: <a href="mailto:kalro.ptc@kalro.org">kalro.ptc@kalro.org</a>


Lead organization and scientists	KALRO Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo Sylvia Kuria, Lusike Wasilwa Ruth Amata and Violet Kirigua
Partner organizations	Kenya seed Company and other seed merchants, Agricultural University Colleges, MoALF, NGO's,

<b>2.1.4 TIMP Name</b>	<b>Ambassador</b>
	
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	The low production (3-5 bags/acre) of Garden peas because of low adoption of improved varieties. The crop is grown by smallholder farmers who attach low commercialization to it. Its consumption is restricted to use of the green pea with little value addition.
What is it? (TIMP description)	Ambassador variety is a standard variety, adapted to warm climate. It has long, straight dark-green pods and matures in 75 days. The variety has a potential of yielding 3 to 6 t /ha
Justification	The variety adapted to warm climate and has long, straight dark-green pods and matures in 75 days. The variety has a potential of yielding 3 to 6 t /ha. It is therefore available to farmers in lower highlands that are warmer than most of the other varieties.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Traders, Processors (canning), Seed dealers, Researchers, Extension service.</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Awareness creation by marketers and processors/farmer contracting</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Partners (Private Companies, NGOs)</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Social media</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Good Marketing Models and path ways</li> <li>• Certified Seed availability and accessibility</li> <li>• Good seed system to ensure quality</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to adapt to new areas</li> </ul>
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes and International research organizations e.g. AVRDC to provide variety, seed and production information</li> <li>• Market agents and stockists to create markets and delivery pathways</li> <li>• Farmers/farmer groups to produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Seed companies for quality seed multiplication</li> <li>• Financial institutions e.g. Banks and other credit facilitators for financial solutions</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Bomet, Kericho
Counties where TIMP will be up scaled	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Tranzoia, Uasin Gishu, Bomet, Kericho
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Labour intensity in planting, weeding, harvesting and threshing</li> <li>• Unorganized marketing channels</li> <li>• Weak seed systems leading to mixing and below potential yields and poor quality ponds and seeds.</li> <li>• Inadequate certified seeds</li> <li>• Lack of seed multipliers and distributors in the new interested Counties</li> <li>• The enterprise of marketing the ponds is controlled by middlemen who exploit the farmers</li> <li>• Limited processing technologies and consumption diversity at the household level</li> <li>• The variety is not adapted to warm and dry areas leading to low yields in</li> </ul>
	<p>those areas</p> <ul style="list-style-type: none"> <li>• Inappropriate of production practices</li> <li>• Diseases and pests control measures</li> <li>• The crop is highly perishable and hence the need to develop hands on handling practices for farm to market</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Initiation of large-scale production where mechanization can be employed</li> <li>• Training on seed production systems</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote marketing models that encourage collective production and marketing</li> <li>• Involve County governments, extension, marketers and processors</li> <li>• Decentralize seed distribution in the target areas and engage County governments in seed distribution to enhance ease of accessibility</li> <li>• Training of households on alternative use and cottage-based processing</li> <li>• Develop varietal lines adapted for the warmer lines</li> <li>• Training growers on good agricultural production practices</li> <li>• Training of producers on good disease and pest control practices</li> <li>• Development and dissemination of good post-harvest practices</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• The demand for garden peas is high and hence the need to upscale production in other suitable areas to satisfy the demand</li> <li>• Farmers need persistent hands on training in proper agronomic practices, Marketing and value addition for proper impact</li> <li>• Perishability of the crop demands proper handling from farm to market</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on nutritive and commercial importance of the variety.</li> <li>• Harmonious gender consideration in research, consumption and marketing. It is cultivated mainly by women hence the need to capacity build them.</li> <li>• Enabling policy and policy review from time to time</li> <li>• Value addition needs enhancement to develop further the canning industry</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 120,000 per acre
Estimated returns	KES 380,800 per acre. Returns =KES 260,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists peas production, value addition and marketing</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for VMG youths and women exists in peas production and value addition</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Farmers have benefited with the crop in Molo Nakuru, Nyandarua, Nyeri, Meru, Kirinyaga, Bomet and other counties</li> </ul>
Application guidelines for users	<b>Reference:</b> Extension Materials, Handouts
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	4. Ready for up-scaling
<b>G. Contacts</b>	
Contacts	The Centre Director, KALRO-PTC Thika; P.O. Box 220 Thika Email: <a href="mailto:kalro.ptc@kalro.org">kalro.ptc@kalro.org</a>
Lead organization and scientists	KALRO Samson Kihara, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Ceaser Kambo and Sylvia Kuria,
Partner organizations	Kenya seed Company and other seed merchants, Agricultural University Colleges, MoALF, NGO's

<b>2.1.5 TIMP Name</b>	<b>Earlicrop</b>	
Category (i.e. technology, innovation or management practice)	Technology	
<b>A: Description of the technology, innovation or management practice</b>		
Problem to be addressed	The low production (3-5 bags/acre) of Garden peas because of low adoption of improved varieties. The crop is grown by smallholder	

	farmers who attach low commercialization to it. Its consumption is restricted to use of the green pea with little value addition.
What is it? (TIMP description)	Earlicrop variety is an early maturing heavy bearing dwarf variety which does not require staking. It produces well filled sweet flavored peas maturing in 65 days is an excellent one for fresh use and freezing. It has a potential of yielding 4 to 6 t/ha under good management
Justification	Garden peas are one of the most important legumes grown in the highlands of Kenya. Peas perform well in the altitudes above 1800 meters above sea level with well distributed rainfall during the growing period. It is a product of huge commercial interest for both local and export market yielding 4 to 6 t/ha.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<ul style="list-style-type: none"> <li>• Farmers, Traders, Processors (canning), Seed dealers, Researchers, Extension service.</li> </ul>
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Awareness creation by marketers and processors/farmer contracting</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• MoA/Extension officers</li> <li>• Farmer research networks</li> <li>• Partners (Private Companies, NGOs)</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Mobile</li> <li>• Social media</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Good Marketing Models and path ways</li> <li>• Certified Seed availability and accessibility</li> <li>• Good seed system to ensure quality</li> <li>• Well organized farmer groups and networks</li> <li>• County and central government support</li> <li>• Funding to adapt to new areas</li> </ul>
Partners/stakeholders for scaling up and their role	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations e.g. AVRDC to provide variety, seed and production information</li> <li>• Market agents and Stokist to create markets and delivery pathways</li> <li>• Farmers/farmer groups to produce</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• Seed companies for quality seed multiplication</li> <li>• Financial institutions e.g. Banks and other credit facilitators for financial solutions</li> </ul>

<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Bomet, Kericho
Counties where TIMP will be up scaled	Meru, Laikipia, Embu, Muranga, Nyeri, Kiambu, Nyandarua, Kisii, Bungoma, Narok, Nakuru, Tranzoia, Uasin Gishu, Bomet, Kericho
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Labour intensity in planting, weeding, harvesting and threshing</li> <li>• Unorganized marketing channels</li> <li>• Weak seed systems leading to mixing and below potential yields and poor quality ponds and seeds.</li> <li>• Inadequate certified seeds</li> <li>• Lack of seed multipliers and distributors in the new interested Counties</li> <li>• The enterprise of marketing the ponds is controlled by middlemen who exploit the farmers</li> <li>• Limited processing technologies and consumption diversity at the household level</li> <li>• The variety is not adapted to warm and dry areas leading to low yields in those areas</li> <li>• Inappropriate of production practices</li> <li>• Diseases and pests control measures</li> <li>• The crop is highly perishable and hence the need to develop hands on handling practices for farm to market</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Initiation of large-scale production where mechanization can be employed</li> <li>• Training on seed production systems</li> <li>• Information dissemination on production practices</li> <li>• Promotion of the variety in the suitable areas</li> <li>• Promote marketing models that encourage collective production and marketing</li> <li>• Involve County governments, extension, marketers and processors</li> <li>• Decentralize seed distribution in the target areas and engage County governments in seed distribution to enhance ease of accessibility</li> <li>• Training of households on alternative use and cottage-based processing</li> <li>• Develop varietal lines adapted for the warmer lines</li> <li>• Training growers on good agricultural production practices</li> <li>• Training of producers on good disease and pest control practices</li> <li>• Development and dissemination of good post-harvest practices</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• The demand for garden peas is high and hence the need to upscale production in other suitable areas to satisfy the demand</li> <li>• Farmers need persistent hands on training in proper agronomic practices, Marketing and value addition for proper impact</li> <li>• Perishability of the crop demands proper handling from farm to market</li> </ul>

Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on nutritive and commercial importance of the variety.</li> <li>• Harmonious gender consideration in research, consumption and marketing. It is cultivated mainly by women hence the need to capacity build them.</li> <li>• Enabling policy and policy review from time to time</li> <li>• Value addition needs enhancement to develop further the canning industry</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 120,000 per acre
Estimated returns	KES 380,000 per acre. Returns =KES 260,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities exist for women and youths to acquire the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for garden pea's cultivation than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• VMGs have limited access to education, training and extension services than men.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by the VMGs due to lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities exist for VMGs to acquire the required credit.</li> <li>• Increased production will lead to increased consumption and utilization of garden peas and hence improved health of VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Farmers have benefited with the crop in Molo Nakuru, Nyandarua, Nyeri, Meru, Kirinyaga, Bomet and other counties</li> </ul>
Application guidelines for users	<b>Reference:</b> Extension Materials, Handouts
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	5. Ready for up-scaling
<b>G. Contacts</b>	

Contacts	The Centre Director, KALRO-PTC Thika; P.O. Box 220 Thika Email: <a href="mailto:kalro.ptc@kalro.org">kalro.ptc@kalro.org</a>
Lead organization and scientists	KALRO Samson Kihara, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Ceaser Kambo and Sylvia Kuria,
Partner organizations	Kenya seed Company and other seed merchants, Agricultural University Colleges, MoALF, NGO's

### Research Gaps in Garden Peas varieties

1. There is no research in Kenya for the breeding of new varieties for Garden peas.
2. The only source of certified seed is from the seed merchants, most of which has been bred outside the country.
3. There are no varieties resistant to common pests and diseases
4. There are no varieties suitable for the low rainfall lowlands of Kenya
5. There is need to develop varieties suitable for the various markets; canning, for export and for direct consumption after cooking

## 2.2 SEED SYSTEMS

<b>2.2.1 TIMP Name</b>	<b>Garden Pea Seed System</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Most Garden pea seeds are not locally produced but imported. This has limited the smallholder farmers' access to quality seed. Farmers also lack awareness of need to use certified seeds.
What is it? (TIMP description)	Available garden seed are mainly imported from outside Kenya making them expensive to small farmers who are the largest base of Garden pea growers in the country. Meeting the demand of the small holder farmers necessitate establishment of a seed system that provides low-cost quality seeds on a timely basis, while taking into consideration of the farmers' needs
Justification	Availability of well-priced quality seed is mandatory if farmers has to get the maximum yields and for the crop to be able to cope with changing environmental stresses including pests and disease. Farmers should be able to know and access the seed sources and have skills of identifying genuine seed.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, Extension officers, processors and other stakeholders
Approaches to be used in dissemination	Demonstrations, Exhibitions, Media, Workshops,

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Good seed systems</li> <li>• Affordability of certified seed</li> <li>• Good extension support</li> <li>• Funding</li> </ul>
Partners/stakeholders for scaling up and their roles	KALRO, KEPHIS, KALRO Seed Unit, Seed companies, NGO, Extension.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Nyeri, Nyandarua, Kirinyaga, Nakuru, Bomet, Kisii, Tharaka-Nithi, Embu, Meru, Kiambu
Counties where TIMP will be up scaled	Nyandarua, Meru, Nyeri, Kirinyaga, Nakuru, Bomet, Kisii, Tharaka-Nithi, Embu, Meru, Kericho, Kiambu, Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Low awareness of the various seed sources</li> <li>• Ignorance of the importance of quality seed</li> <li>• Low financial ability to regularly produce early generation seed leading to low quality of certified seed</li> <li>• Lack of funds to produce enough certified seed</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Information dissemination on the seed and seed sources</li> <li>• Support generation of basic and breeders seed (early generation seed)</li> <li>• Support Production of enough seed through formal seed system</li> <li>• Policy on community seed production</li> <li>• Train on own seed selection and preservation after testing</li> </ul>
Lessons learned in up scaling if any	Partnership with stakeholders in solving a challenge quickly yield results
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Awareness of benefits of quality seed to the growing society</li> <li>• Create an enabling environment for seed access to farmers</li> <li>• Policy on community seed production should be put in place to guide in enabling farmers produce seed</li> <li>• Reduce marketing blocks and improve the seed system</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Estimated cost 120,000
Estimated returns	380,000 per acre = 260,000
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists peas in quality garden peas seed production and marketing</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists in quality garden seed production</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Laikipia Meru, Nyeri, Nakuru Embu and other counties have benefited from growing the crop with improved seeds
Application guidelines for users	<b>Reference</b> Extension materials and handouts
<b>F: Status of TIMP readiness</b> (1-ready for up scaling, 2-requires validation; 3-requires further research)	1-ready for up scaling
<b>G: Contacts</b>	
Contacts	Officer In Charge – KALRO PTC, CD – KALRO Sericulture, CD – KALRO Kandara P.O. Box 220 Thika 01000
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Antony Nyaga, Eliud Gatambia, CM Kambo, Sylvia Kuria, Charity Gathambiri
Partner organizations	Kenya seed Company, KEPHIS, AFA, STAK

## 2.3 GOOD AGRICULTURAL PRACTICES AND FOOD SAFETY MANAGEMENT SYSTEM

<b>2.3.1 TIMPs name</b>	<b>Good Agricultural Practices (GAP</b>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	

Problem addressed	Detection of food contaminants in both fresh produce including Garden pea, has been rampant. This results in declining food safety and quality, therefore frustrating sustainable farming of these crops for both food and income generation. Most markets continue to impose more stringent measures (to ensure the safety of consumers) for those wishing to access the said markets. These contaminants also impact negatively on the environment, worker safety and health; and consequently, making it difficult to implement traceability, as most producers do not give accurate information on inputs and processes used during production, to avoid commercial losses and even prosecution
What is it? (TIMP description)	<p>It is a systematic process of implementing a standardized production system globally designed to reassure consumers about how food is produced on the farm, pre-farm gate or on-farm standards.</p> <p>It is not about a specific crop production, but the process through which production takes.</p> <p>The four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely.</p> <p>Commercialization of Garden peas on the domestic and export level highly depends on compliance to these market standards.</p>
Justification	There is need to arrest the rampant detection of food contaminants in Garden peas. Good Agricultural Practice(s) (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture [by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM)] to continuously improve farming systems. GAP is of utmost importance in protecting consumer health by ensuring safety throughout the food chain. It needs to be enforced and transparent, not only from the table but also upstream to include suppliers (e.g. quality of fertilizers and plant protection products) and all the value chain players including providers of logistics and farm equipment.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	All value chain players including producers, extension staff, processors, transporters and market outlet operators including wholesale and retail chains, domestic markets and farm gate handlers
Approaches to be used in dissemination	FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, Agricultural Innovation Platforms and larger plot demonstrations.

Critical/essential factors for successful promotion	Policy support from government particularly the enforcement of KS1758 (a domestic scope standard that has been passed after undergoing public participation stage).
Partners/stakeholders for scaling up and their roles	Producer organizations (FPEAK, FPC, KFC, AGAK etc), NGO's, MOALID, Private extension providers, CoG, and other value chain players
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Already promoted in Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasingishu, Nakuru, Kericho, Bomet and other horticultural hot spots
Counties where TIMP will be up scaled	All counties in Kenya particularly where Garden Pea is grown
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack/inadequate knowledge on the benefits GAPs</li> <li>• Lack of legislative mechanisms to support the GAP, in particular the domestic scope</li> <li>• The perception that GAP is oppressive rather than supportive</li> </ul>
Recommendations for addressing the challenges	Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	Supportive policy of national and county governments to promote adaption of GAP's.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Difficult to put monetary gains figures as most involves social and welfare issues in addition than markets lost due to non-compliance
Estimated returns	Benefits are mostly social welfare issues in addition to additional markets accessed
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to agricultural information, technology and knowledge on GAP than men.</li> <li>• Women have limited access to education, training and extension services on GAP than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Proper application of GAP will led to improved health of the various gender categories due to consumption of clean health millets that are free from hazards.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled.</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs have limited access to education, training and extension services on GAP than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge on GAP than men.</li> <li>• High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Proper application of GAP will led to improved health of the various gender categories due to consumption of clean health millets that are free from hazards.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Small, holders in groups in the counties of Kirinyaga, Nyeri, Meru, Nakuru and other counties have been able to produce and export produce from horticultural crops that are certified after adopting and complying with GAP's.
Application guidelines for users	<ul style="list-style-type: none"> <li>• Global GAP Version 6 (Code Ref: IFA V5.2_Feb19; English Version Versionn /Edition Update Register Page: 45 of 45) - <a href="https://www.globalgap.org/.content/.galleries/documents">https://www.globalgap.org/.content/.galleries/documents</a></li> <li>• KALRO-USAID Training And Extension Manual On Good Agricultural Practices (Gap) - Nov. 2017</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<ul style="list-style-type: none"> <li>• Director, KALRO Seed –Thika; info.ptc@kalro.org</li> <li>• Centre Directors; KALRO Kandara,</li> <li>• KALRO NSRC;</li> <li>• Director General KALRO</li> </ul>
Lead organization and scientists	KALRO: Nyaga A., Ndungu J., Gatambia E., Kambo C., Kuria, S Musyoki R. Wasilwa, L., Kirigua, V., Muriuki SJN.
Partner organizations and their roles	MoALF&I, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, County governments, NGO's, Universities

<b>2.3.2 TIMP Name</b>	<b>Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Garden Peas Chain in Kenya</b>
Category (i.e. technology, Innovation or management practice)	Management Practice


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


Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• Training of stakeholders on GAP, Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP)</li> <li>• Garden Pea innovation platforms</li> <li>• FFBS sessions</li> <li>• Through common interest groups discussions, field days, exhibitions, radio, TV and social media (Whats App, Facebook, Twitter).</li> <li>• Agricultural Innovation Platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Formation of “experts” team composed of HACCP specialists, food scientists, microbiologists, representative of the Garden Pea (and other similar crops) value chain players, public health officers, and a quality control and safety specialists from the competent authorities to guide the process</li> <li>• Local and National governments support</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>• KALRO, National Agricultural Research Institutes (NARIs) and International research organizations</li> <li>• Market players</li> <li>• Farmers/farmer groups</li> <li>• County governments, central governments e.g. Chiefs, Agricultural Extension (Formal and informal) for policy, awareness and dissemination</li> <li>• NGOs for farmer organizing and mobilization e.g. SACDEP</li> <li>• National competent authorities</li> <li>• Analytical testing services</li> <li>• Processors and local traders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<ul style="list-style-type: none"> <li>• Not promoted in any county of Kenya</li> </ul>
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> <li>• All counties growing and consuming Garden Pea in Kenya.</li> </ul>
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Inadequate funds to reach value chain actors</li> <li>• New concept not very well known among the primary stakeholders and market outlets</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Funding of dissemination platforms</li> <li>• Training of all stakeholders on food safety</li> </ul>
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> <li>• None since scaling up has not been done</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Garden pea being observed by stakeholders as a food and commercial crop that requires protection from contamination</li> <li>• Use of less toxic crop protection methods in handling crop health issues</li> </ul>

	<ul style="list-style-type: none"> <li>Establishment of practical and acceptable food handling protocols at both county and National levels</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	<ul style="list-style-type: none"> <li>Women have less access to agricultural information, technology and knowledge on HACCP than men.</li> <li>Women have limited access to education, training and extension services on HACCP than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean health millets that are free from hazards.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled.</li> <li>VMGs have limited access to education, training and extension services on HACCP than men.</li> <li>VMGs have less access to agricultural information, technology and knowledge on HACCP than men.</li> <li>High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Proper application of HACCP will led to improved health of the various gender categories due to consumption of clean health millets that are free from hazards.</li> </ul>
○ <b>E: Case studies/profiles of success stories</b>	
Success stories	N/A
Application guidelines for users	<ul style="list-style-type: none"> <li>HACCP general guidelines - <a href="https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/">https://www.fao.org/fao-who-codexalimentarius/codex-texts/codes-of-practice/en/</a></li> <li>General principles of food hygiene - <a href="https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&amp;url=https%25253A%25252F%25252Fworkspace.fao.org">https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&amp;url=https%25253A%25252F%25252Fworkspace.fao.org</a></li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling;
○ <b>G: Contacts</b>	

Contacts	<p>The Institute Director, FCRI Njoro; Email <a href="mailto:director.fcrinjoro@kalro.org">director.fcrinjoro@kalro.org</a></p> <p>The Institute Director, KALRO-HRI Thika; E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a></p> <p>Director, KALRO Seeds, E-mail: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a></p> <p>The Centre director, KALRO-Muguga Email: <a href="mailto:kalro.FCRC@kalro.org">kalro.FCRC@kalro.org</a></p> <p>The Centre director, KALRO-Kabete; E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>The Institute director, KALRO-FCRI Kitale; E-mail: <a href="mailto:director.fcric@kalro.org">director.fcric@kalro.org</a></p>
Lead organization and scientists	<ol style="list-style-type: none"> <li>1. Mr. John N. Ndung'u, FCRI - KALRO Njoro</li> <li>2. Antony Nyaga, KALRO Seeds Thika</li> <li>3. Dr. Francis Wayua, KALRO Kakamega</li> <li>4. Dr. Lusike Wasilwa, Crops Director, KALRO Headquarters</li> <li>5. Mrs. Violet Kirigua, KALRO Headquarters</li> <li>6. Beatrice Wanjiku, KALRO Njoro</li> </ol>
Partner organizations	MoA, AFA, FPEAK, PCPB, AAK, KEPHIS, KEBS, County governments, NGO's and Universities.


## 2.4 AGRONOMIC MANAGEMENT PRACTICES

<b>2.4.1 TIMPs name</b>	Adopting row planting
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
<p>Problem addressed</p>  <p style="text-align: center;">Random planting</p>	<p>Most farmers growing Garden pea do so by random dibbling without row planting leading to inefficient use of land. This has several disadvantages including suboptimal plant populations that are uneconomical. Random dibbling and intercropping limits to use of agronomic practices such as weed control, pest and disease management.</p>

<p>What is it? (TIM P description)</p>  <p>Row planting</p>	<p>Row planting involves planting seeds with definite spacing within and between the rows. Each variety has its recommended spacing for optimum yields. The technology will involve establishment of rows and management of intra and inter-row spacing.</p>
<p>Justification</p>	<p>Row planting results in optimum utilization of land leading to high yields per unit area. The row planting also eases crop management practices like weeding, fertilizer application, spraying and harvesting. Row planting helps in control of pests and disease</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Seed Producers, extension staff, processors</p>
<p>Approaches to be used in dissemination</p>	<p>On-farm experimentation and dissemination, Farmers Field Schools, Farmer groups trainings</p> <ul style="list-style-type: none"> <li>• FFBS, Field days, shows, farmer to farmer communication, leaflets,</li> <li>• Larger plot demonstrations.</li> </ul>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• Participatory Implementation,</li> <li>• stakeholder capacity building,</li> <li>• functioning seed system, stakeholder networks and reliable market</li> </ul>
<p>Partners/stakeholders for scaling up and their roles</p>	<ul style="list-style-type: none"> <li>• NGOs, extension,</li> <li>• private service providers</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted, if any</p>	<p>Nyandaruwa (Other counties with high potential include Kiambu, Nakuru, Uasin Gishu and Laikipia Counties)</p>
<p>Counties where TIMP will be upscaled</p>	<p>Nyandaruwa (Other counties with high potential include Kiambu, Nakuru, Uasin Gishu and Laikipia Counties)</p>
<p>Challenges in dissemination</p>	<ul style="list-style-type: none"> <li>• There is inherent attitude in favour of random planting among farmers that may be difficult to change</li> <li>• There is always some resistance to change</li> </ul>
<p>Recommendations for addressing the challenges</p>	<ul style="list-style-type: none"> <li>• Continuous training to achieve attitude change</li> <li>• Field demonstrations and</li> <li>• Farmers field Schools</li> </ul>

Lessons learned in up scaling, if any	No up scaling carried out so far
Social, environmental, policy and market conditions necessary	A positive attitude for change will enable adoption of the technology
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	3,000/- per acre
Estimated returns	380,000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists peas in quality garden peas</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists in quality garden seed production</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Laikipia Meru, Nyeri, Nakuru Embu and other counties have benefited from growing the crop with improved seeds
Application guidelines for users	<b>Reference</b> Extension materials and handouts
<b>F: Status of TIMP readiness</b> (1-ready for up scaling; 2-requires validation; 3-requires further research)	1-ready for up scaling
<b>G: Contacts</b>	
Contacts	Officer In Charge – KALRO PTC, CD – KALRO Sericulture, CD – KALRO Kandara P.O. Box 220 Thika 01000



Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Antony Nyaga, Eliud Gatambia, CM Kambo, Sylvia Kuria, Charity Gathambiri
Partner organizations	Kenya seed Company, KEPHIS, AFA, STAK

<b>2.4.2 TIMPs name</b>	<b>Intercropping/crop rotation</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Continuous cultivation of one type of crop on same land normally results in buildup of pest and disease incidences. There is also depletion of nutrients within one level of soil depth. The decline of amount of land available for crop production also call for intercropping
What is it? (TIMP description)	Crop rotation and intercropping are encouraged to resolve soil constraints and maximize utilization of available land. This technology will involve appropriate crops for rotation and intercropping, intercropping patterns and suitable rotation calendar. The two practices will also consider crops that are important for pest and disease management such as garlic and onion.
	
Justification	Crop rotation will discourage build-up of pests and diseases and depletion of specific nutrients at different soil depths. Rotation and /or intercropping of garden pea will benefit the accompanying crop with nitrogen fixation. The space on the farm will be efficiently utilized in properly planned intercrop.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, extension staff, processors, Service providers
Approaches to be used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Farmers need to readily adopt intercropping and rotation recommendations.</li> <li>• Selection of crops for rotation and intercropping should be professionally done.</li> </ul>
Partners/stakeholders for scaling up and their roles	NGOs, extension, private service providers
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	(Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Negative attitude towards intercropping/rotation.</li> <li>• There may be conflict of opinion on application of the practices.</li> <li>• Land non-availability for rotation</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Continuous training on the two practices</li> <li>• Efficient land use planning</li> </ul>
Lessons learned in up scaling, if any	No up scaling carried out so far
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Farmers should be educated on the practices</li> <li>• Favorable environmental conditions for production of the alternative crops.</li> <li>• The national and county governments should support the adoption of intercropping/rotation by the farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	36,000/- per acre
Estimated returns	380,000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists peas in quality garden peas seed production and marketing</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists in quality garden seed production</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Laikipia Meru, Nyeri, Nakuru Embu and other counties have benefited from growing the crop with improved seeds
Application guidelines for users	<b>Reference</b> Extension materials and handouts
<b>F: Status of TIMP readiness</b> (1-ready for up scaling; 2-requires validation; 3-requires further research)	1-ready for up scaling
<b>G: Contacts</b>	
Contacts	Director KALRO Seeds, CD – KALRO Sericulture, CD – KALRO Kandara P.O. Box 220 Thika 01000
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Antony Nyaga, Eliud Gatambia, CM Kambo, Sylvia Kuria, Charity Gathambiri
Partner organizations	Kenya seed Company, KEPHIS, AFA, STAK

<b>2.4.3 TIMPs name</b>	<b>Crop training (staking and trellising)</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Garden pea is a climbing/creeping herb with weak stems that require support for upright growth through staking and trellising. Without these practices, the plants will creep on the ground leading to poor quality pods as well as pest and disease infestation.

<p>What is it? (TIMP description)</p> 	<p>Staking and trellising are forms of plant training that encourage upright and above the ground growth of plants. Farmers are encouraged to train their garden peas plants using locally available materials</p> 
<p>Justification</p>	<p>Staking and trellising will promote production of clean produce. Staking also eases operations such as weeding and harvesting, reducing infestation of pests and diseases. It encourages vertical utilization of space.</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Producers, extension staff, processors, private service providers</p>
<p>Approaches to be used in dissemination</p>	<p>On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.</p>
<p>Critical/essential factors for successful promotion</p>	<p>Availability of staking materials and labour</p>
<p>Partners/stakeholders for scaling up and their roles</p>	<p>NGOs, extension, private service providers</p>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted, if any</p>	<p>Nakuru</p>

Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• The labour intensive nature of the task may discourage farmers from practicing it.</li> <li>• Scarcity of training materials</li> </ul>
Recommendations for addressing the challenges	Clearly demonstrate the economic advantage of the practice.
Lessons learned in up scaling, if any	No up scaling carried out so far
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• There may be conflict over use of staking materials with other uses such as fuel wood.</li> <li>• Farmers may clear forest cover to use as staking materials.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	42,000/- per acre
Estimated returns	380,000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as land, credit, and quality seeds than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women have limited access to markets as they sometimes cannot travel to far markets due to their domestic roles</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists in Staking and trellising</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit, and quality seeds</li> <li>• VMGs have limited access to training and extension services</li> <li>• VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• VMGs have limited access to seed and information on new varieties and production techniques</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths and women exists in Staking and trellising</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Laikipia Meru, Nyeri, Nakuru Embu and other counties have benefited from growing the crop with improved seeds
Application guidelines for users	<b>Reference</b> Extension materials and handouts

<b>F: Status of TIMP readiness</b> (1-ready for up scaling; 2- requires validation; 3-requires further research)	1-ready for up scaling
<b>G: Contacts</b>	
Contacts	Officer In Charge – KALRO PTC, CD – KALRO Sericulture, CD – KALRO Kandara P.O. Box 220 Thika 01000
Lead organization and scientists	Kenya Agricultural & Livestock Research Organization (KALRO) Antony Nyaga, Eliud Gatambia, CM Kambo, Sylvia Kuria, Charity Gathambiri
Partner organizations	Kenya seed Company, KEPHIS, AFA, STAK

## 2.5 SOIL FERTILITY MANAGEMENT AND WATER CONSERVATION

<b>2.5.1 TIMP Name</b>	<b>Rapid soil testing services</b>
Category (i.e. technology innovation, or management practice)	Innovation
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Conventional methods for soil testing are expensive for farmers, results take long and are not reproducible. Further, conventional methods have not provided solutions for paired soil and leaf testing to determine health of soil and crop simultaneously. Current methods do not provide a framework for large scale assessment of geo-referenced sampled points using standardized protocols. Limited access to soil testing services (centralized soil testing laboratories and cost).
What is it? (TIMP description)	This is a dry method for soil testing using simplicity of light—the interaction of electromagnetic radiation with matter to characterize biochemical composition of a soil and/or plant tissue. Requires partners involved (ICRAF, iSDA and Soil Cares) to work closely with KALRO and county agricultural officers to sensitize farmers to embrace the testing method. This innovation will involve working closely with agronomists to generate specific fertilizer recommendation driven by soil and crop data obtained.
Justification	Soil testing is the basis for good fertilizer management that maintains the productivity of soil and improves the quality of crops. It promotes more efficient fertilizer use and prevents environmental pollution from excess fertilizer application, and cost efficiency. However, limited access to soil testing services is depriving the farmers’ ability to make informed decisions with regard to soil management and fertilizer use.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension officers

Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>Farmer visits</li> <li>Training in workshops</li> <li>Publicity campaigns done at county levels.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Availability of the necessary equipment for rapid on the spot soil testing.</li> <li>Established rapport between farmers and the technical personnel involved in soil testing.</li> <li>Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins.</li> <li>A well designed storage system for keeping information obtained at farm level including (Group Positioning System readings, physical description of the locations, raw measured scanned data, fertilizer recommendation according to crop type suitability)Availability a van to mount the equipment.</li> <li>Farmers must understand, trust, and be willing to act upon the information provided</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>County government extension services; providing the link to farmers given that agriculture is devolved.</li> <li>Soilcares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF,</li> <li>ICRAF and iSDA tests and validates the recommendation obtained in collaboration with SoilCares and KALRO.</li> <li>Fertilizer companies; To provide fertilizer blends according to soil health status</li> <li>Agro dealers to stock required fertilizers that is readily available to farmers</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Technology has not been promoted though testing has been ongoing in a few counties
Counties where TIMP will be promoted	All the 24 KCSAP counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>It requires continuous updating methods to improve recommendations.</li> <li>Lack of awareness on the importance of regular testing of soil quality</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>Awareness creation, intensive farmer field training (capacity building)</li> <li>Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis.</li> <li>Automated pipelines for updating existing recommendation methods.</li> </ul>
Lessons learned in scaling up	<ul style="list-style-type: none"> <li>Timely affordable soil information will guide on fertilizer use.</li> <li>Farmers have reported frustration when they apply the wrong fertilizers and see no results because they did not take the first step</li> </ul>

	to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Sulphur.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Socially acceptable-brings income, increases food production, nutrition security and family cohesion.</li> <li>• Environmentally friendly-farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water.</li> <li>• Increased productivity will provide supply to the markets</li> <li>• Supporting frameworks/policies are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Soil testing equipment and consumables, sampling and packaging materials, personnel. The actual costs will be determined upon consultation.</li> <li>• Shipping selected soil and plant materials for further testing and results verification in a certified lab.</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Dependent on the enterprise adopting the service, but estimated at least 30% of current returns and no doubt will be making agronomy great again.</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• Women have less access to credit to pay for the rapid soil testing services than men.</li> <li>• Women and youth have limited access to land for finger millet cultivation than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• Bringing services closer to the users saves time and resources to the various gender categories using the rapid soil testing.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in rapid soil testing.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for finger millet cultivation than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in rapid soil testing.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>Has been tested used successfully by other organizations like ICRAF, SoilCares &amp; KESREF.</p> <p>It has been adopted at Kenya cane testing centre for checking maturity level and quality of sugarcane.</p>

Application guidelines for users	<ul style="list-style-type: none"> <li>• A handheld scanner to testing soils and crops in the field</li> <li>• Community soil sampling champions are identified and trained on good soil sampling procedures.</li> <li>• Soil and crop is analysed and the results including fertilizer recommendation generated on site.</li> </ul>
<b>F: Status of TIMP readiness</b> (1=Ready for up-scaling; 2=Requires validation; 3=Requires further research)	2 Requires validation
<b>G: Contacts</b>	
Contacts	Director, Environment & Natural Resources, KALRO secretariat
Lead organization and Scientists	KALRO; C. Kibunja, A. Sila, D. Kamau, A. Esilaba
Partner organizations	County governments in the 24 counties, SoilCares, ICRAF and iSDA

Research Gaps:

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

<b>2.5.2 TIMP Name</b>	<b>Garden Pea Nutrition Management</b>
Category (i.e. technology innovation, or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The yields obtained by farmers are low because of the declining soil fertility in their fields as a result of continuous use of the farms. Garden pea is a heavy consumer of potassium and micronutrients whose deficiencies manifest in physiological disorders
What is it? (TIMP description)	Farmers will be advised to use recommended fertilizer and manures under an integrated soil fertility management regime and nutrient preservation procedures. The technology will involve methodologies for rhizobium

	inoculation, identification and management of soil related physiological disorders including hollow heart and bud drop.
Justification	There is need for sustainable intensification of garden pea production in view of diminishing land size, declining soil fertility and increasing demand for food. Soil nutrient management is key to achieving this.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies, private service providers
Approaches to be used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, FFSBS, Training manuals, brochures, leaflets, fact sheets
Critical/essential factors for successful promotion	Participatory Implementation, stakeholder capacity building, Functioning seed system, Stakeholder networks
Partners/stakeholders for scaling up	NGOs, extension, private service providers
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMP will be promoted	All Garden pea growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Most farmers do not regard nutrient provision to garden pea as important and may not easily adopt the technology.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Clear demonstration of the effect of crop nutrition, rhizobium and physiological disorders.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Understanding the attitude of community towards nutrient management; household man-power endowment. Community youth, men, and women ratios.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	<ul style="list-style-type: none"> <li>•</li> </ul>
Basic costs	<ul style="list-style-type: none"> <li>• Not yet estimated</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Not yet estimated</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of handling and application hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited access to land than men.</li> <li>• Women and youth may also have limited access to inputs such as manures than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunity exists for women to access the required credit through the women enterprise funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land than men.</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as manures than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>• Increased production due to use of manure will lead to increased consumption and utilization of garden peas hence improved health of VMGs.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	-The Molo garden pea farm harvesting millions -What it takes to produce food for global market; Daily Nation: 16 January 2015
Application guidelines for users	Garden pea production leaflet
<b>F: Status of TIMP readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	KALRO-PTC
Lead organization and scientists	The Center Director, KALRO- Kabete, P.O. Box 14733-00800 Nairobi <a href="mailto:cdnarl@kalro.org">cdnarl@kalro.org</a> Fredrick Wandera
Partner organizations	MoA, Universities and NGOs

### Research Gaps:

1. Determination of location-specific soil nutrient status

<b>2.5.3 TIMP Name</b>	<b>Integrated Manure Management</b>
Category (i.e. technology, innovation or management practice)	<ul style="list-style-type: none"> <li>• Management practice</li> </ul>
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and poor soil health

	Poor manure management and handling leading to increased GHG emissions
What is it? (TIMP description)	Integrated Manure Management (IMM) is the optimal, site- specific handling of livestock manure from collection, through treatment and storage up to application to garden peas.
Justification	The decline in soil fertility in smallholder system is a major factor inhibiting agricultural development on farms. It is estimated that soils are being depleted at annual rate of 22kg/ha for nitrogen, 2.5kg/ha for phosphorous, and 15kg/ha for potassium. Manure plays an essential role in the nutrient cycle where crops grow on land to feed livestock, which in return feeds the land with their manure. Recycling the (macro and micro) nutrients in manure reduces the need for additional fertilizer purchase. In general, adding manure to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Given the acute poverty and limited access to mineral fertilizers, manure has the potential providing the limiting nutrients and improving the soil health.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Open and field days Exchange visits Demonstration farms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Training on feeding, management and use of manure</li> <li>• Dissemination approach used to reach target farmers</li> <li>• Model demonstration plots using cereal crops</li> </ul>
Partners/stakeholders for scaling up and their roles	County governments, Provide extension services, farmer mobilization and policy formulation ILRI, technical backstopping NGOs – micro financing services
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Tharaka Nithi, Kajiado, Uasin Gishu
Counties where TIMP will be promoted	Bomet, Kericho, Laikipia, West Pokot, Taita Taveta, Nyandarua, Lamu, Tana river, Baringo, Marsabit, Garissa, Siaya, Kisumu
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of model demonstration farms</li> <li>• Cultural challenges -Lack of interest by pastoral communities</li> <li>• Lack of continuity in training of extension and farmers in the skill for manure management</li> <li>• Lack of proper mobilization mechanism for reaching many farmers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establishment of many demonstration plot by counties</li> <li>• Capacity building of pastoral communities on manure management and its benefit</li> <li>• Continuous capacity building of demonstration farmers and extension workers</li> <li>• Use of approaches to mobilize farmer to attend demonstration forums</li> </ul>
Lessons learned if any	<ul style="list-style-type: none"> <li>• Proper use of manures improves soil fertility</li> </ul>


	<ul style="list-style-type: none"> <li>• Use of manures enhances crop productivity</li> <li>• Skills in manure preparation, storage and application</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Applying manure to soils saves on purchase of inorganic fertilizer, increases crop yield and saves water.</li> <li>• Propagation of invasive species when the seed is ingested by the animal and passed to crop field</li> <li>• Manure can harbour pathogens which can cause disease outbreaks to livestock</li> <li>• Contamination of water sources by leaching of nutrients Organic manures when poorly handled increase GHG emissions.</li> <li>• However, IMM provides practices that are able to minimize GHG emissions.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• Proper handling of manure needs labour for collecting the manure, building a compost heap, maintaining it and finally transporting and applying it field which take a lot of effort and time</li> <li>• Using locally available manure/composts saves on purchase of inorganic fertilizer.</li> </ul>
Estimated returns	Returns dependent on crop and crop varieties in the value chain where IMM is practised
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of handling and application hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited access to land than men.</li> <li>• Women and youth may also have limited access to inputs such as manures than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunity exist for women to access the required credit through the women enterprise funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land than men.</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as manures than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in various areas as for instance in the provision of finances to VMGs.</li> <li>• Increased production due to use of manure will lead to increased consumption and utilization of garden peas hence improved health of VMGs.</li> </ul>

<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income
Application guidelines for users	The guideline focus on the following areas:- <ul style="list-style-type: none"> <li>• Animal feeds</li> <li>• Livestock housing and manure collection</li> <li>• Manure storage to preserve nutrient and avoid loses</li> <li>• Manure treatment for ease of transport and application in the field</li> <li>• Timing of application for maximum utilization by the crop</li> <li>• Anaerobic digestion for biogas production</li> <li>• Regular analysis of manure to ascertain the quality</li> <li>• Manure/Composts take a long time to cure, hence need good planning</li> </ul>
<b>F: Status of TIMP readiness</b> (1=Ready for up scaling; 2=Requires validation; 3=Requires further research)	Requires Validation
<b>G: Contacts</b>	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, S. Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamuongo, A. Esilaba, F. Wandera
Partner organizations	County government, Private Public Partnerships

### Research Gaps:

1. Promote IMM management practice in counties that have not practised it.
2. Conduct nutrient budget study on selected farms utilizing manures (including composts) in each of the 24 Counties.

<b>2.5.4 TIMP name</b>	<b>Use of drip irrigation in Garden pea production</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	With increasing effects of climate change, there are growing incidences of unpredictable weather and erratic rainfall patterns. □ Crops under rain fed production systems are likely to suffer from effects of drought and insufficient amounts of rainfall during the cropping seasons.
What is it? (TIMP description)	Use of drip irrigation has been reported to save up to 70% of water used by garden peas in rain fed systems. This technology combines well with the use of row planting and optimum spacing. Drip lines with optimized spacing are laid along the garden pea rows at planting. Optimum amount of water is supplied to

	the plant during the critical stages of flowering and pod filling to maximize yields. Drip irrigation is suitable for small holder farms
Justification	In order to achieve the desired high yields, the crop needs to receive optimum amounts of water at the rightful time of its growth cycle. For garden pea, soil moisture deficit reduces growth, hampers nodulation, interferes with flowering and pod filling thereby resulting in low yield and quality of pods.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, extension staff, processors, farmers
Approaches to be used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training manuals
Critical/essential factors for successful promotion	Favourable conditions for drip irrigation especially water supply Source of capital for initial investment
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• NGOs to rally farmers</li> <li>• Public and extension service providers to conduct farmer advisory</li> <li>• Input suppliers to provide farm inputs and equipment at cost</li> <li>• County Governments department of agriculture to provide policy direction at the local level</li> <li>• National government- to provide resource for national policies on agriculture and water use</li> <li>• Research bodies to develop technologies</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nyandarua County
Counties where TIMP will be up- scaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Scarcity of capital for initial investment in drip irrigation</li> <li>• Conflict over water resource has been reported</li> <li>• Limited know-how among farmers</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Linking farmers to financial and other credit institutions</li> <li>• Collective approach to investment through farmer groups</li> <li>• Continuous training of farmers</li> <li>• To encourage formation of water users association to reduce conflicts</li> </ul>
Lessons learned in up scaling, if any	No up scaling carried out so far
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Harmony in communal utilization of water should be cultivated</li> <li>• All forms of water harvesting should be encouraged</li> <li>• Sustainable supply of water for irrigation</li> <li>• Policy on rational distribution of available water should be observed.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	

Basic costs	Inputs materials include water source, drip lines, drippers, and pumping unit, filtering and fertilizing systems. ¼ acre costs between KES 50, 000 to KES 100,000
Estimated returns	<ul style="list-style-type: none"> <li>Income from drip system rises by as much as 35% stemming from the management of crop water stresses.</li> <li>Increased water saving means more water is available for other competing needs (domestic, livestock or industrial).</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Women and youths have less access to credit required to install drip irrigation.</li> <li>Women have less access to technology and information on the TIMP.</li> <li>Women have less access to education, training and extension services.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Employment opportunities exist for youths in installing the drip irrigation kits.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have less access to credit required to install drip irrigation.</li> <li>VMGs have less access to technology and information on the TIMP.</li> <li>VMGs have less access to education, training and extension services.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Employment opportunities exist for youths in installing the drip irrigation kits.</li> </ul>
<ul style="list-style-type: none"> <li><b>E: Case studies/profiles of success stories</b></li> </ul>	
Success stories	<ul style="list-style-type: none"> <li>There are many successful farmer drip irrigation models across the country implemented by government and other development partners. It is noted that linking markets to crops under drip is crucial for sustainability.</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>Never bury emitters underground unless they are made to be buried</li> <li>Don't bury drip tube, moles or other rodents will chew it</li> </ul>
<b>F: Status of TIMP readiness</b> (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	1 Ready for up scaling
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, P. O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO; Isaya Sijali
Partner organizations	AMIRAN Kenya, HortiPro, Agro-Irrigation, Aqua- Valley Services Ltd, Davis & Shirtliff, and many Micro-finance Institutions

### Research Gaps:

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

<b>2.5.5 TIMP name</b>	<b>Integrated Soil Fertility Management</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 soil fertility, low organic matter, restoring soil structure and conserving the limited available moisture in crop production.
What is it? (TIMP description)	A set of soil fertility management practices that include the use of fertilizers, locally available organic inputs and improved seed combined to adapt practices to local conditions. The ISFM places emphasis on the importance of using often scarce resources like fertilizer and organic inputs efficiently through techniques such as fertilizer banding (field application of fertilizer directly in area of root-zone to increase the potential for uptake) and micro dosing (applying small quantities of fertilizer with the seed at planting time and a few weeks after emergence)
Justification	Soils within the farming system are heterogeneous due to spatial variability in soil fertility. These inherent differences arise from the parent material from which the soil has evolved, and the position in the landscape that influences how soil develops. A large proportion of soils in the KCSAP target project counties are derived from some of the oldest land surfaces which, due to weathering and cropping, have low nutrients. Where younger, volcanic soils occur these are inherently richer in nutrients, but may have other soil fertility problems such as fixation of some critical nutrients such as phosphorus. Past management of the soils also has a major influence on soil fertility which in turn influences productivity. These challenges call for an integrated soil fertility management (ISFM) approach that combines appropriate interventions on soil management that include fertilizer use and crop agronomy. The aim of ISFM is therefore to optimize agronomic use efficiency of the applied nutrients for improved crop productivity.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Training in workshops</li> <li>• On-farm visits</li> <li>• Farmer field schools (FFS)</li> <li>• On-farm demonstrations (during FFS)</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of affordable and quality manure, fertilizers and clean planting materials</li> <li>• Take into account variability between farms, in terms of farming goals and objectives, size, labour availability, ownership of livestock, importance of off-farm income; and</li> <li>• Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.</li> </ul>
Partners/stakeholders for scaling up and their roles	County government extension services; Provide link with farmers.

	Community farmer groups; play coordination role for ease in problem identification and dissemination.
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMP will be promoted	Bomet, Kericho, West Pokot, Taita Taveta, Lamu, Nyandarua, Tana River, Baringo, Marsabit, Garissa, Kajiado, Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Change of mindset in some regions/cultures that organic manures cannot be applied on crops</li> <li>• Misconceptions that chemical fertilizer damage the soils</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness trainings on role of organic manures in crop cultivation</li> <li>• Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers</li> </ul>
Lessons learned if any	For ISFM to succeed, good germplasm/seed/seedlings, etc is required since farmers tend to re-use previous planted materials.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Practice is socially acceptable,</li> <li>• Environmentally friendly,</li> <li>• Increased productivity will provide supply to the markets,</li> <li>• Supporting frameworks/policies are available</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	This is a technically demanding technology and high cost in areas where application of ISFM is non-responsive
Estimated returns	Farmers who have adopted ISFM technologies have more than doubled their agricultural productivity and increased their farm-level incomes by 20 to 50 percent
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• It is labour intensive hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited access to credit to purchase the required inputs such as such as fertilizers than men.</li> <li>• Women and youth have limited access to land for finger millet cultivation than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunity exist for women to access the required credit through the women enterprise funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for finger millet cultivation than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• It is labour intensive hence may not be adopted by some VMGs who are elderly.</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase the required inputs such as fertilizers than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action in various areas as for instance in the provision of finances to VMGs</li> <li>• Increased production due to use of the TIMP will lead to increased consumption and utilization of finger millets and hence improved health of VMGs</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>• ISFM successes have been reported in sorghum and millet value chains at Machakos where the productivities have been improved</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients.</li> <li>• Ensure that good agronomic practices are upheld</li> <li>• For sustainability, lone use of inorganic or organic materials should be avoided.</li> </ul>
<b>F: Status of TIMP readiness</b> (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	2 Requires Validation
<b>G: Contacts</b>	
Contacts	Centre Director, KALRO Kabete
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. Esilaba, J. Ndufa
Partner organizations	County governments KEFRI

### Research Gaps:

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

<b>2.5.6. TIMP name</b>	Conservation Agriculture (CA)
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed:	Land degradation characterized by the declining soil fertility, low yields, ncreased soil moisture stress, increased soil erosion and loss of biodiversity

What is it? (TIMP description)	Conservation agriculture is an approach to farming which can sustainably increase crop yields. The various practices that make up this approach follow key principles that target to conserve the soil, soil moisture, and soil-nutrients, and stabilise land production while reducing production costs. Conservation agriculture principles are: 1. Minimal soil disturbance, 2. Permanent ground cover - maintenance of a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops), 3. Crop rotation or sequences and associations of crops including trees, which could include nitrogen-fixing legumes
Justification	Land productivity is decreasing leading to decreased yield. Continuous land operation continues to emit more GHGs (Carbon) responsible for the climatic changes. Conservation agriculture (CA) has potential to: Enhance management of soil fertility and organic matter, and improvement of the efficiency of nutrient inputs, helping to produce more with proportionally less fertilizer. Rotations and crop associations that include legumes are capable of hosting nitrogen-fixing bacteria in their roots; this contributes to optimum plant growth without increased GHG emissions induced by fertilizer production. Avoidance of tillage minimises occurrence of net losses of carbon dioxide by microbial respiration and oxidation of the soil organic matter and builds soil structure and biopores through soil biota and roots. The protective soil cover of leaves, stems and stalks from the previous crop shields the soil surface from heat, wind and rain, keeps the soil cooler and reduces moisture losses by evaporation. Helps to reduce soil compaction and plough pans and regenerates degraded lands
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension Agents, Researchers
Approaches to be used in dissemination	Agricultural shows, Mass media, Chief's Baraza, Exhibitions, Farmer field Schools (FFS), On-farm and on-station demonstrations, Field Days, Extension Officers
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Training on principles and benefits of CA</li> <li>• Model demonstration using crops</li> </ul>
Partners/stakeholders for scaling up, their roles and stage of involvement	<ul style="list-style-type: none"> <li>• County Extension officers - Dissemination of information, capacity building</li> <li>• NGO's (African Conservation Network, One Acre Fund)- Capacity Building, Dissemination of information</li> <li>• CIAT, FAO – capacity building</li> <li>• County Governments - Funding CA activities, support capacity building, enabling environment and supportive policies</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega

Counties where TIMP will be up scaled	Bungoma, Meru, Embu, Tharaka Nithi, Laikipia, Kakamega, Machakos, Makueni
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Non-availability of crop residue in suitable quantities</li> <li>• Competition for crop residues with other uses like wood fuel and livestock</li> <li>• Land tenure (farmers reluctant to invest in CA where they do not have clear land rights)</li> <li>• Limited knowledge on the incremental benefits of CA</li> <li>• Limited access to CA implements</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Enhance Public Private Partnerships (PPP) to support increased production and market access</li> <li>• Improve KALRO and county government capacity to train and re-tool technical team so as to enhance uptake of the technology</li> <li>• Allocation of more funds for continued research and dissemination of this technology would aid increased uptake of CA with agroforestry</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Uptake of CA technology increases with the realized incremental benefits over time</li> <li>• Continuous capacity building increases CA technology uptake</li> </ul>
Social, environmental, policy and market conditions necessary for development and dissemination	<ul style="list-style-type: none"> <li>• Develop Integrated Herbicide Management Plan – pre-emergence and post-emergence herbicides</li> <li>• Reliable technology adoption and suitable price and market access for produce under CA</li> <li>• Continuous capacity building of the community on the benefits of CA technology</li> <li>• County policies that support households investing in CA with inputs like implements</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Costs related to ripping services and herbicides amount to KES 5000/acre. This is apart from the normal inputs of seed and fertilizer when establishing. But the costs of reduce over the years, while the returns increase
Estimated returns	<ul style="list-style-type: none"> <li>• Reduction of costs associated with tillage-induced soil erosion and degradation i.e. 40% of land degradation</li> <li>• Returns on conserving soil exceeding 150 ton/hectare annually and associated increased productivity</li> </ul>
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology may reduce women work burden when it comes to weeding.</li> <li>• Women and youth have limited access to land for finger millet cultivation than men.</li> </ul>

	<ul style="list-style-type: none"> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women to perform other productive activities due to reduced weeding resulting from CA.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• The technology may reduce VMGs work burden when it comes to weeding.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• VMGs have limited access to land for finger millet cultivation than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youths to perform other productive activities due to reduced weeding resulting from CA.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers and agro-pastoralists who adopt the technology have had sustainable source of income and increased resilience
Application guidelines for users	<p>When implementing the 3 principles of CA, one needs to note the following</p> <ol style="list-style-type: none"> <li>1. Timely Operations - preparing the land in good time before the rains start; planting soon after an effective rainfall event; weeding at appropriate times and intervals; doing effective pest and disease control before either spread too widely.</li> <li>2. Precise Operations - Precise measurements of row and plant spacing, evenness of depth and placement of soil amendments and covering of seed are also important. Planting should be done on the same lines each season</li> <li>3. Inputs – Equipment, seeds, herbicides, manures/fertilizers – use the right inputs</li> <li>4. Livestock - try to keep livestock out of the fields, even after harvesting the crop.</li> </ol>
<b>F: Status of TIMP readiness</b> (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	1 Ready for up scaling
<b>G: Contacts</b>	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, E. Mutuma
Partner organizations	County government, Private Public Partnerships

### Research Gaps:

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

<b>2.5.7. TIMP name</b>	<b>Bench terraces</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Bench terraces consist of a series of beds which are more or less level running across a slope at vertical intervals, supported by steep banks or risers (walls or bunds). The flat beds created by bench terraces enable the cultivation of crops on medium to steep slopes. The technology is highly suitable for Semi-arid to humid regions of rainfall, 700 mm or more; medium to steep slopes (12- 47%) (Bench terraces are not recommended for slopes less than 12%); soil depth of greater than 50 cm; and areas with no gullies, nor stones.
Justification	Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
<b>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>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the county extension service providers.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour as the technology is labour intensive.</li> <li>• Farmers and extension service with skills to design and construct contour bunds.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools.</li> <li>• External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	Busia, Kisumu, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos, Taita Taveta, Isiolo, Lamu.
Challenge(s) in development and dissemination	<ul style="list-style-type: none"> <li>• Increased risk of soil erosion if terraces are improperly laid out</li> <li>• Labour intensive during construction and maintenance and many farmers may find it difficult to implement at large scale</li> <li>• Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour.</li> <li>• Training youthful farmers to be champions of making bench terraces construction at the Ward level/village level.</li> <li>• Training on site specific designs and construction of bench terraces</li> <li>• fast-track land registration</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>• Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance.</li> <li>• Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</li> <li>• Conducting well publicized campaigns has been found to add to the success of soil and water conservation.</li> <li>• Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Enforce policies on soil and water conservation at the County level</li> <li>• Create awareness on the importance of soil and water conservation</li> <li>• Avail low cost technologies for soil and water conservation</li> <li>• Policies that support individual land tenure systems</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• The main input cost is the labour for Bench terrace preparation. The cost will depend on the land size, labor costs and the landscape terrain/slope</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• The returns depends on the value chain being addressed</li> </ul>
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited access to land for finger millet cultivation than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths males employment exist in performing the task of bench terraces.</li> </ul>
VMG issues and concerns in development,	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for finger millet cultivation than men.</li> </ul>

dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths males employment exist in the task of bench terraces.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	Mukethe Mbithi is a member of the Kyungu Mwethya group in machakos "Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed It into the river and the maize grew short. But when we made terraces the soil erosion stopped and we got good crops.
Application guidelines for users	<p>Terraces draining in one direction should be at least 100m or more. The length can be slightly increased in arid and semi-arid regions. The width of the bench (flat part) is determined by soil depth, crop requirements, and tools to be used for cultivation. Optimum width of terrace benches ranges from 2.5 to 5 m for manually constructed ones and from 3.5 to 8 m for machine built and tractor-cultivated ones.</p> <p>Terraces should drain runoff along the horizontal gradient of the slope, either in outward or reverse direction. The outward gradient can range from 0.5% in arid or semi-arid regions to 3% in humid regions with clay soils. Maximum gradients can be 5% for reverse terraces. In high rainfall areas (more than 1000 mm annually), it is necessary to make additional drainage provisions off the terraces – although this has a risk of causing erosion on very steep slopes. These additional drainage channels should be trapezoidal in shape and planted with grass to prevent erosion. Machine construction is possible on slopes of 12-36% while manual construction can be used on slopes of 12-47%.</p>
<b>F: Status of TIMP readiness</b> 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments extension offices.

<b>2.5.8 TIMP name</b>	<b>Fanya Juu Terraces</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off; low soil water retention capacity in most soils
What is it? (TIMP description)	Fanya juu terraces (juu is Swahili word for ‘up’) are constructed by excavating soil and throwing it up-slope to make an embankment. The embankment forms a runoff barrier and the trench (ditch) is used to retain or collect runoff. The embankments are usually stabilized with fodder grasses. Crops, such as bananas, pawpaw’s, citrus and guava, are grown in the ditches. Through gradual redistribution of soils within the field, the terraces level off. The technology is highly suitable in low annual rainfall areas (less than 700 mm); moderate slopes (less than 20%); deep soils (more than 60 cm); and hilly areas that are subject to widespread erosion.
Justification	The impacts of climate change such as low and erratic rainfall continue to threaten agricultural production, food security and livelihoods especially in the ASALs. Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. Conservation of soil and moisture through construction of terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: On-farm demonstrations during farmer field schools Training in workshops. Extension information materials which will be distributed to farmers through farmer groups and the county extension service providers.
Critical/essential factors for successful promotion	Availability of labour as the technology is labour intensive. Farmers and extension service with skills to design and construct contour bunds. Land tenure systems that allows individual ownership
Partners/stakeholders for scaling up and their roles	County government extension service providers – delivery of information to farmers, technology access, capacity building Community farmer groups – Provide on farm demonstration plots to hold farmer field schools. External service providers – capacity building and access to technology
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	Busia, Kisumu, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos, Taita Taveta, Isiolo, Lamu.

Challenge(s) in development and dissemination	<p>Increased risk of soil erosion if terraces are improperly laid out</p> <p>Labour intensive and many farmers may find it difficult to implement at large scale</p> <p>Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds</p>
Suggestions for addressing the challenges	<p>Farmers need to be supported with appropriate equipment for preparation of terraces for efficiency and increased output per man hour.</p> <p>Training youthful farmers to be champions of fanya juu terraces construction at the Ward level/village level.</p> <p>Training on site specific designs and construction of fanya juu terraces</p> <p>Fasttrack land registration</p>
Lessons learned, if any	<p>Fanya juu terracing is popular due largely to the rapid benefits it gives in terms of soil and water conservation.</p> <p>Existence of well-developed self-help groups can lead to successful soil and water conservation activities.</p> <p>Conducting well publicised campaigns has been found to add to the success of soil and water conservation.</p> <p>Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.</p>
Social, environmental, policy and market conditions necessary	<p>Enforce policies on soil and water conservation at the County level</p> <p>Create awareness on the importance of soil and water conservation</p> <p>Avail low cost technologies for soil and water conservation</p> <p>Policies that support individual land tenure systems</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for terrace preparation. The cost will depend on the land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited access to land for finger millet cultivation than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youths males and men exist in performing the task.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for finger millet cultivation than men</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youths males and men exist in performing the task.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	



Success stories, if any	Over 50,000 smallholder farmers in lower eastern counties of Kenya are recording a more than doubling of yields and reduced soil erosion after embracing a soil conservation scheme that involves digging of trenches in hillside to trap runaway water and soil.
Application guidelines for users	The 'fanya juu' trench is 60 cm wide by 60 cm deep, and the bund 50 cm high by 150 cm across 19. In arid regions the trenches can be enlarged to 150 cm deep and 100 cm wide. Distance between bunds can be from 5 m on steep slopes to 20 m on gentle slopes. Stone terrace walls can be built to reinforce the bunds on very steep slopes to allow surplus water to pass between the stones without damaging the terrace. Excess water can be drained from the trenches using cut-off drains.
<b>F: Status of TIMP readiness</b> 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamungo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments extension service.

<b>2.5.9 TIMP name</b>	<b>Grass strips</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	The risk of soil erosion and increased run off
What is it? (TIMP description)	Grass strips are dense strips of grass planted up to a meter wide, along a contour. With time, silt builds up above the strip and benches are formed. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. They are a popular and easy way to terrace land, especially in areas with relatively good rainfall. The technology is suitable in regions with fairly gentle slopes (0 - 6%); grass is needed for fodder; and high rainfall areas.
Justification	Agricultural production is threatened in many parts of the Kenya by soil moisture stress and serious soil erosion. Conservation of soil and moisture through construction of grass strips has led to better and more reliable crop yields.
<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>• On-farm demonstrations during farmer field schools</li> <li>• Training in workshops.</li> <li>• Extension information materials which will be distributed to farmers through farmer groups and the county extension service providers.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of labour</li> <li>• Availability of land, apart from cropland.</li> <li>• Farmers and extension service with skills to design and construct stone lines.</li> <li>• Land tenure systems that allows individual ownership</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County government extension service providers – delivery of information to farmers, technology access, capacity building</li> <li>• Community farmer groups – Provide on farm demonstration plots to hold farmer field schools; provide collective labor.</li> <li>• External service providers – capacity building and access to technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	Busia, Kisumu, Bomet, Kericho Tharaka Nithi, West Pokot, Nyeri, Machakos, Taita Taveta, Isiolo, Lamu.
Challenge(s) in development and dissemination	Labour intensive for maintaining and controlling grass from becoming a weed Reduced land area for crop production
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Farmers need to be supported with appropriate tools and suitable grass varieties.</li> <li>• Capacity building on the maintenance of grass strips.</li> <li>• Training on site specific designs and layout</li> </ul>
Lessons learned, if any	<ul style="list-style-type: none"> <li>• Establishment of grass strips induces a process of natural terracing on slopes as soil collects behind the grass barrier, even in the first year.</li> <li>• Grass strips can be very appropriate for farmers who cut and carry fodder for their animals.</li> <li>• Grasses are also used as mulch for crops by farmers.</li> </ul>
Social, environmental, policy and market conditions necessary	Enforce policies on soil and water conservation at the County level Create awareness on the importance of soil and water conservation Avail low cost technologies for soil and water conservation
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The main input cost is the labour for establishing grass strips. The cost will depend on the type of grass to be planted, land size and the landscape terrain/slope
Estimated returns	The returns depends on the value chain being addressed and also type of grass
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened.</li> </ul>

	<ul style="list-style-type: none"> <li>• Women and youth have limited access to land for garden peas cultivation than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for the various gender categories i.e. youths, women and men performing the task.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for garden peas cultivation than men</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> <li>• The technology is labour intensive and may be difficult for the VMG to implement in the field.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities for youths exist in performing the task.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories, if any	
Application guidelines for users	Spacing between grass strips depends on the slope of the land. It can be 20-30 m on gentle slopes and 10-15m on steep land. Grass strips can be planted along ditches to stabilize them, or on the rises of bench terraces to prevent erosion. The grass needs to be trimmed regularly, to prevent shading and spreading to cropped areas. Various grass species are used, e.g., Vetiver, Napier, Guinea and Guatemala depending on what is locally available. Vetiver grass is drought resistant and good for reducing erosion.
<b>F: Status of TIMP readiness</b> 1. Ready for up scaling, 2=Requires validation; 3=Requires further research	1 Ready for up scaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, Between Nairobi School and Kabete Army barracks P.O. Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO, E. Mutuma; J. Wamuongo; M. Wairimu; P. Kitiem, J. Mwaura; D. Kamau.
Partner organizations	County Governments extension service.

## 2.6 GARDEN PEA CROP HEALTH

<b>2..6.1 TIMP name</b>	<b>Integrated Management of Pod borer</b> <i>(Etiella zinckenella; Maruca urtrata)</i>
 <p>Lima bean pod borer (<i>Etiella zinckenella</i>)</p>  <p>Legume pod borer (<i>Maruca vitrata</i>)  <b>Source: alchetron.com</b></p>	
Category (i.e. innovation or technology, management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Reduced yield of 30-70% and quality of garden pea.
What is it? (TIMP description)	Integrated management of the pod borer includes the use of various pest control strategies. The strategies include cultural, biological and chemical control. In order to realize an effective management programme for this insect, one has to start chronologically from preventive to curative pest control measures i.e. from cultural to chemical control. The trend is to start with the most environmentally friendly (cultural) strategy and move towards chemical pest control methods. This management practice starts with pest scouting/ monitoring, pest identification and establishment of economic

	<p>threshold and finally a decision is made on which of the following pest control measures to use.</p> <p><b>Cultural control:</b></p> <ul style="list-style-type: none"> <li>• Scout the fields twice weekly, looking under the leaves and bud areas for pod borers</li> <li>• Remove and destroy or plough down crop residues from damaged plants in production fields</li> <li>• Rotate garden pea with cereals</li> <li>• Establish repellent/ trap crops</li> <li>• Incorporate manure to promote plant vigour</li> <li>• Practice crop rotation for a period of at least 6-8 weeks and ensure that the young crop is not planted next to an infested older crop</li> <li>• Weed fields since some weeds in the could serve as alternative hosts and harbour the pest season after season</li> </ul> <p><b>Biological control</b></p> <ul style="list-style-type: none"> <li>• Use neem-based products e.g Nimbecidine, Neemroc 0.03% and Achook 0.15%.</li> <li>• Use biopesticides such as Halt 500 WP (<i>Bacillus thuringiensis</i>), Heltic SC (<i>Helicoverpa armigera</i> SNP 8% w/w 2x99 polyhedra per ml or Nimbecidine EC (Azadirachtin 0.03%).</li> </ul> <p><b>Chemical control</b></p> <ul style="list-style-type: none"> <li>• Apply relatively safe/soft pesticides such as PYNEEM 20EC if attack severity is high.</li> </ul>
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<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.46,500</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 70%. Therefore, the

	estimated returns will be 380,000-266, 000= <b>Ksh. 114,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None

Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO: Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S., Ndegwa, A., Ndubi, J., Masinde Muliro University of Science and Technology: Ogemah,V. <b>CABI: Duncan Chacha</b></p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps

- Explore bio-control options for controlling the pod borers to minimize on pesticide use
- Explore the efficacy of Indigenous Technical Knowledge (ITK) in management of pod borers under high pressure
- Validation of tolerance of new varieties to pod borers

<p><b>2.6.2 TIMP name</b></p>  <p><b>Source: pestadvisories.usu.edu</b></p>	<p><b>Integrated Management of Thrips (<i>Thrips angusticeps</i>) on Garden pea</b></p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p><b>A: Description of the technology, innovation or management practice</b></p>	
<p>Problem addressed</p>	<p>Reduced yield of 30-70% and quality of garden pea.</p>
<p>What is it? (TIMP description)</p>	<p>Integrated management (IPM) of thrips involves the use of a combination of cultural, biological and chemical control methods. These are;</p> <p><b>Cultural Control</b></p> <ul style="list-style-type: none"> <li>• Maintain a healthy crop as it will tolerate thrips and keep the field weed free</li> <li>• Avoid planting new crop near an existing infected field</li> <li>• Mulch fields as this helps reduce thrips population</li> <li>• Use overhead irrigation where possible to reduce spread of thrips</li> <li>• Remove and destroy volunteer plants and debris that may harbour thrips</li> <li>• Uproot heavily infested plant material and burn</li> <li>• Apply soapy sprays (mix 5 teaspoon full of soap powder or chopped bar soap with cold water and dissolve and spray on the infested plants)</li> </ul>

	<ul style="list-style-type: none"> <li>• Use blue sticky cardboard traps to attract thrips.</li> </ul> <p><b>Biological control</b></p> <ul style="list-style-type: none"> <li>• Apply biocontrol agents e.g Beauvitech WP (<i>Beauveria bassiana</i>) or Bio-Power 1.5L (<i>Beauveria bassiana</i>), or Botanigard ES (Azadirachtin),</li> <li>• Spray neem-based products like neemroc EC and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water).</li> </ul> <p><b>Chemical Control</b></p> <ul style="list-style-type: none"> <li>• Spray with Spinosad based products eg tracer 480 SC at 4mls per 20lts of water or lambda cyhalothrin products at 7ml per 20l of water or duduthrin at 65mls per 20l of water or Karate at 20gms/ 20l</li> <li>• Use synthetic insecticides with PHI of 3 days or less since garden pea is harvesting at very short intervals.</li> </ul>
Justification	<p>Thrips cause considerable reduction in yield and lower the seed (pod) quality. Where the pest is severe and not controlled plants become greatly reduced in size and yield. Losses of above 30-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic pesticides in their control. Integrated Management of pests considering food safety concerns should be highly advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On-farm trials and Demonstrations</li> <li>• ASK shows</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> </ul>

	<ul style="list-style-type: none"> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> <li>• Print media brochures</li> </ul> <p>Conferences and journals</p>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on insects</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage Insects</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in insect management</li> <li>• PCPB to promote registration of insecticides for insect management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMP will be upscaled	Counties with high potential for upscaling;


	Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• Inadequate knowledge on IPM strategies on insect pests infesting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in insect management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the insects</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the insect management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh. 30,100</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 70%. Therefore, the estimated returns will be 380,000-266,000= <b>Ksh.114,000</b>

Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>• Opportunities for women exists in thrips management</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete,  Box 14733-00800, NAIROBI.  Tel: +254-020-2464435 Ext. 300  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p>

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Lead organization and scientists	<p>KALRO: Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S., Ndegwa, A., Ndubi, J.,  Masinde Muliro University of Science and Technology:  Ogemah, V.  <b>CABI: Duncan Chacha</b></p>
Partner Organizations	<p>CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities,  County governments</p>

### Research Gaps

- Capacity building on insect identification and management
- Validation of the use of yellow and blue sticky traps in the management of insects
- Validation of biopesticides and synthetic pesticides in the management of garden pea insects
- Determine the effects of major pests on garden pea yield, quality and implication on economic returns for the farmer

2.6.3 TIMP name	<p><b>Integrated Management of Pea Aphid (<i>Acyrtosiphon pisum</i>)</b></p>  <p><b>Source:</b> Infonet-biovision.org</p>
Category (i.e. technology, innovation or management practice)	<p>Management practice</p>
<p><b>A: Description of the technology, innovation or management practice</b></p>	

Problem addressed	Aphid feeding on garden pea causes yield losses of 30-70% and reduced quality of the crop. Aphis infestation also transmits a number of viruses to garden pea leading to death of the plants.
What is it? (TIMP description)	<p>Integrated management of aphids includes the use of various pest control strategies. The strategies include cultural, biological and chemical control. In order to realize an effective management programme for the aphids, one has to start chronologically from preventive to curative pest control measures i.e. from cultural to chemical control. The trend is such that you start with the most environmentally friendly (cultural) strategy as you move towards chemical pest control methods. This management practice starts with pest scouting/ monitoring, pest identification and establishment of economic threshold and finally a decision is made on which of the following pest control measures to use.</p> <p><b>Cultural Control</b></p> <ul style="list-style-type: none"> <li>• Prepare land well and apply 10 kg CAN/acre and 14 kgs/acre DAP to increase plant vigour</li> <li>• Control ants by ploughing and flooding the field to destroy the colonies, expose eggs and larvae to predators</li> <li>• Conserve natural enemies (e.g. flower bugs, lady bird beetles, praying mantis, hover flies, green lace wing, long horned grass hoppers and spiders) by planting lantana hedges to act as breeding grounds for predators</li> <li>• Rotate with non-host crops e.g. maize, upland rice, sorghum, okra, sugarcane, and sunflower to prevent build-up of population. Avoid alternate host crops such as beans, green grams, lucerne, pigeon pea</li> <li>• Remove heavily infested plant parts and destroy by burning</li> <li>• Apply neem-based products (e.g. neem oil 40ml/20lts of water, Achook) 2 times/month</li> <li>• Spray with soapy water solution (mix 1 tablespoon of teepol detergent with 4 lts of water or use strong jet of water to wash off aphids)</li> </ul> <p><b>Chemical Control</b></p> <p>Use only pest control products recommended by Pest Control Products Board (PCPB) such as:</p> <ul style="list-style-type: none"> <li>• Use Danadim Blue 40 EC(Dimethoate 400 g/L)</li> <li>• Duduthrin 1.75 EC (<i>Labdacyhalothrin</i> 17.5 g/L)</li> <li>• Spray using 10 - 15 mls/20lts of Karate, Atom or Decis at the rate of 10-15mls/20lts of water</li> </ul>
Justification	Aphids cause considerable reduction in yield and lower the seed (pod) quality. Where the pest is severe and not controlled plants become greatly reduced in size and yield. Losses of above 30-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic pesticides in their

	control. Integrated Management of pests considering food safety concerns should be highly advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On-farm trials and Demonstrations</li> <li>• ASK shows</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> <li>• Print media brochures</li> <li>• Conferences and journals</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on insects</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage Insects</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> </ul>


	<ul style="list-style-type: none"> <li>• KALRO to continually undertake research in insect management</li> <li>• PCPB to promote registration of insecticides for insect management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMP will be upscaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on insect pests infesting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in insect management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the insects</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the insect management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.58,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 70%. Therefore, the estimated returns will be 380,000-266, 000= <b>Ksh.114,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Molo garden pea farmers are harvesting a lot of peas -What it takes to produce food for global market; Daily Nation: 16 January 2015
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	

Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO: Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S., Ndegwa, A., Ndubi, J., MMUST, <sup>2</sup> Ogemah, V. <b>CABI:</b> Duncan Chacha</p>
Partner organizations	<p>CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments</p>

### Research Gaps

- Capacity building on insect identification and management
- Validation of the use of yellow and blue sticky traps in the management of insects
- Validation of biopesticides and synthetic pesticides in the management of garden pea insects
- Determine the effects of major pests on garden pea yield, quality and implication on economic returns for the farmer

<b>2.6.4 TIMP name</b>	<b>Integrated Management of leaf miners (<i>Liriomyza</i> spp.)</b>
	 <p><b>Source:</b> Infonet Biovision.org</p>
Category (i.e. technology, management practice)	Management practice

<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Increased yield loss 20- 70% and poor quality produce.
What is it? (TIMP description)	<p>Integrated management of leaf miners consists of several approaches applied in an integrated manner to break the insect cycle. The following options can be applied;</p> <p><b>Cultural Control</b></p> <ul style="list-style-type: none"> <li>• Plant clean seedlings free from all stages of the moth.</li> <li>• Rotate with non-host crops such as maize, beans and cabbages.</li> <li>• Remove and destroy wild host plants such as sodom apple around the farm.</li> <li>• Remove and burn all infected crop residues.</li> <li>• Remove infested leaves before the caterpillar pupates inside and becomes an egg-laying adult.</li> <li>• Bury deep (50-100 cm) infested plants and foliage.</li> <li>• Use black sticky traps - 24 pcs/acre, placed 15-20 cm above the ground.</li> </ul> <p><b>Bio-control</b></p> <ul style="list-style-type: none"> <li>• Use of <i>Bacillus thuringiensis</i> controls outbreaks.</li> <li>• Pheromone traps: These will trap males, reducing males available for mating with females resulting into females laying unfertilized eggs thus no caterpillars. This can be purchased from Kenya Biologics- 0710724629</li> <li>• Use black sticky traps from Koppert Kenya- 0723-144-690</li> </ul> <p><b>Chemical Control</b></p> <ul style="list-style-type: none"> <li>• Spray spinetoram (Radiant 120 SC(R)) at rate of 18-30ml/20lts of water or Chlorantraniliprol (Corragen 20 SC(R)) at rate of 2ml/20lts of water or Belt insecticide. Avoid using same active ingredient for more than 3 times in a season.</li> </ul>
Justification	Leaf miner cause considerable reduction in yield and lower the seed (pod) quality. Where the pest is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-70% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot

	<p>of synthetic pesticides in their control. Integrated Management of pests considering food safety concerns should be highly advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's</p>
<p>Approaches used in dissemination</p>	<ul style="list-style-type: none"> <li>• On-farm trials and Demonstrations</li> <li>• ASK shows</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> <li>• Print media brochures</li> </ul> <p>Conferences and journals</p>
<p>Critical/essential factors promotion</p>	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on insects</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage Insects</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>

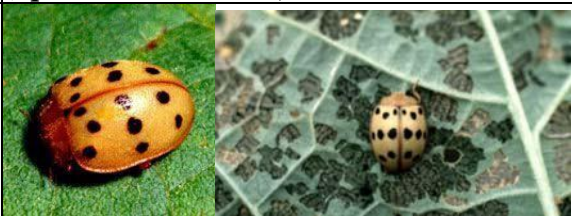
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in insect management</li> <li>• PCPB to promote registration of insecticides for insect management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMP will be upscaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on insect pests infesting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>

Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in insect management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the insects</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the insect management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.43,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 70%. Therefore, the estimated returns will be 380,000-266,000= <b>Ksh.114,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> </ul>

	<ul style="list-style-type: none"> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director KALRO</b> Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO: Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S., Ndegwa, A., Ndubi, J., Masinde Muliro University of Science and Technology: Ogemah, V. <b>CABI: Duncan Chacha</b></p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

## Research Gaps

- Capacity building on insect identification and management
- Validation of the use of yellow and blue sticky traps in the management of insects
- Validation of biopesticides and synthetic pesticides in the management of garden pea insects
- Determine the effects of major pests on garden pea yield, quality and implication on economic returns for the farmer

2.6.5 TIMP name	<b>Integrated Management of Mexican bean beetle (<i>Epilachna varivestis</i>)</b>
	 <p><b>Source: Bugwood.org</b></p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Reduced yield of 30-70% and quality of garden pea.
What is it? (TIMP description)	<p>Integrated management of the beetle includes the use of various pest control strategies. The strategies include cultural, biological and chemical control. In order to realize an effective management programme for this insect, one has to start chronologically from preventive to curative pest control measures i.e. from cultural to chemical control. The trend is such that you start with the most environmentally friendly (cultural) strategy as you move towards harsh (chemical) pest control methods. This management practice starts with pest scouting/ monitoring, pest identification and establishment of economic threshold and finally a decision is made on which of the following pest control measures to use</p> <p><b>Cultural control</b></p> <ul style="list-style-type: none"> <li>• Preventive control measures are sanitation by removal of plants and all debris as soon as harvesting is over.</li> <li>• Hand pick and destroy the beetles at the beginning of infestation as this will help to reduce the population density</li> <li>• Remove alternative host near the crop</li> </ul> <p><b>Biological control</b></p>

	<ul style="list-style-type: none"> <li>• Use natural enemies such as domestic chicken and allow perching birds to prey on beetles</li> <li>• Use biopesticides such as Nimbecidine EC (<i>Azadirachtin 0.03%</i>).</li> </ul> <p><b>Chemical control</b>  Use only pest control products recommended by Pest Control Products Board (PCPB) such as:</p> <ul style="list-style-type: none"> <li>• Bulldock star EC 262.5 (<i>Beta-cyfluthrin 12.5 g/L +Chlorpyrifos 250 g/L</i>)</li> <li>• Tata-alpha 10 EC (<i>Alpha-cypermethrin (10 g/L)</i>)</li> <li>• Decis 2.5 EC (<i>Deltamethrin25g/L</i>)</li> <li>• Duduthrin 1.75 EC (<i>Lambdacyhalothrin 17.5 g/L</i>)</li> </ul> <p>Synthetic pesticides should be used as the last option since most of them are detrimental to the environment</p>
Justification	<p>Mexican beetle is a serious pest of garden pea in many growing areas of the country. Infested plants wilt and die at very early stage. The pest attacks all the stages of the crop cycle and its effect can be devastating. If uncontrolled the pest can wipe out a whole cotton field within a month resulting into a total crop failure. It is therefore advisable to use integrated management approach since it is cost effective, gender sensitive, socially acceptable, economically viable and environmentally friendly. This pest management practice leads to increased crop yields while at the same time conserving the natural environment.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On-farm trials and Demonstrations</li> <li>• ASK shows</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> <li>• Print media brochures</li> </ul> <p>Conferences and journals</p>

<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on insects</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage Insects</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
<p>Partners/stakeholders for scaling up</p>	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in insect management</li> <li>• PCPB to promote registration of insecticides for insect management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted, if any</p>	<p>Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo</p>
<p>Counties where TIMP will be upscaled</p>	<p>Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties</p>
<p>Challenges in dissemination</p>	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on insect pests infesting garden pea and losses attributed to them</li> </ul>


	<ul style="list-style-type: none"> <li>Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>PCPB enhance registration of crop protection products</li> <li>Training of stakeholders in IPM options</li> <li>Establish garden pea innovation platforms for technology disseminations</li> <li>Dissemination of integrated pest management practices and safe use of pesticides</li> <li>Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>Sensitization is necessary for people to appreciate the use of IPM in insect management</li> <li>Adoption of good agricultural practices by farmers is key in management of the insects</li> <li>Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>Favorable environmental conditions</li> <li>Willingness of stakeholders to participate</li> <li>Favorable environmental conditions</li> <li>Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality</li> <li>Producers willing to adopt the insect management practices</li> <li>Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh. 33,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 70%. Therefore, the estimated returns will be 380,000-266, 000= <b>Ksh.114,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>Women have limited access to education, training and extension services than men</li> <li>Women have less access to agricultural information, technology and knowledge</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya.</p>

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Lead organization and scientists	KALRO: Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S., Ndegwa, A., Ndubi, J., Masinde Muliro University of Science and Technology: Ogemah, V. <b>CABI: Duncan Chacha</b>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

### Research Gaps

- Capacity building on insect identification and management
- Validation of the use of yellow and blue sticky traps in the management of insects
- Validation of biopesticides and synthetic pesticides in the management of garden pea insects
- Determine the effects of major pests on garden pea yield, quality and implication on economic returns for the farmer

<b>2.6.6 TIMP name</b>	<b>Integrated Management of Red Spider Mites (Two-spotted spider mite) <i>Tetranychus urticae</i></b> 
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Cause substantial yield loss, especially during the dry season or on stressed plants. Up to 30% yield loss is attributed to spotted spider mites attacks on garden pea.
What is it? (TIMP description)	Integrated management of red spidermites consists of several approaches applied in an integrated manner to break the cycle of the insect. These include:  <b>Cultural Control</b> <ul style="list-style-type: none"> <li>• Keep the farm weed free from the alternative hosts such as solanum family crops that may harbour red spider mites</li> <li>• Avoid planting tomato next to infested field or crops.</li> </ul>

	<ul style="list-style-type: none"> <li>• When moving through the farm, start with the healthy area before moving to infected section.</li> <li>• Conserve natural enemies or release purchased predatory Phytoseilus species from Real IPM or Dudutech Ltd.</li> <li>• Use overhead irrigation as it helps in drowning the mites hence reducing their population</li> <li>• Spray with neem extracts (500 grams of leaves in 5 litres of water)</li> <li>• Prun overcrowded plants and destroy the crop debris by burning.</li> </ul> <p><b>Bio-control control</b></p> <ul style="list-style-type: none"> <li>• Spray with neembicidine based products such as Achook</li> <li>• Release predatory mites (Phytotech and Amblytech from dudutech) Phytoseiulus persimilis species and Amblyseius cucumeris</li> <li>• Conserve natural enemies in the environment or release purchased predatory Phytoseilus species from Real IPM or Dudutech Ltd</li> </ul> <p><b>Chemical Control</b></p> <ul style="list-style-type: none"> <li>• Spray with abamectin 18g/kg based synthetic pesticides (Dynamec 20EC 5ml/20litres water, Knockbect 40EC, 10 ml/20 Litre water) or</li> <li>• Spray with Amitraz 200g/L based miticides (Kilitac 20EC, Mitac 20 EC. Rate 10ml/20Litre water)</li> </ul>
Justification	Insect pests are a major challenge in garden pea production and it is attributed to farmers recycling seed from previous season’s crop which carry insect pests and also, farmers do not know how to manage insect pests. Presence of Integrated management options will provide farmers with a basket of management options that they can use to manage the spotted spidermites infestation on garden pea.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR’s
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On-farm trials and Demonstrations</li> <li>• Agricultural shows (ASK shows, Field days, exhibitions)</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> </ul>

	<ul style="list-style-type: none"> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> <li>• Print media brochures</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on insects</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage Insects</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in insect management</li> <li>• PCPB to promote registration of insecticides for insect management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo

Counties where TIMP will be upscaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on insect pests infesting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in insect management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the insects</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the insect management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.47,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 30%. Therefore, the estimated returns will be 380,000-114,000= <b>Ksh.266,000</b>


Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
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Lead organization and scientists	<p><b>KALRO:</b>  Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S.,  Ndegwa, A., Ndubi, J.,  Masinde Muliro University of Science and Technology:  Ogemah, V.  <b>CABI:</b> Duncan Chacha</p>
Partner organizations	<p>CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities,  County governments</p>

#### Research Gaps

- Capacity building on insect identification and management
- Validation of the use of yellow and blue sticky traps in the management of insects
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- Determine the effects of major pests on garden pea yield, quality and implication on economic returns for the farmer

#### Management of Garden Peas Diseases

<b>2.6.7 TIMP name</b>	<b>Integrated Management of Root knot nematode (<i>Meloidogyne</i> spp.)</b>
	 <p><b>Source:</b> Pea Diseases - Vikaspedia</p>
Category (i.e. innovation or technology, management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Nematode infestation on garden pea can cause reduced yield of 20-60%.

<p>What is it? (TIMP description)</p>	<p>Integrated management of root knot nematodes consists of several approaches applied in an integrated manner to break the cycle of the nematode. These include:</p> <p><b>Cultural control</b></p> <ul style="list-style-type: none"> <li>• Always analyse the soil for presence of nematodes at KALRO Kabet</li> <li>• Use tolerant varieties or clean seedlings to plant</li> <li>• Apply heavy mulch with maize stover to reduce nematodes in soil</li> <li>• Crop rotate using maize, millet for 2yrs</li> <li>• Avoid planting spinach, capsicum and eggplant</li> <li>• Uproot infected plants and destroy by burning or burying 1m deep</li> <li>• Before planting, solarise soil using polythene paper of gauge 150.</li> <li>• Apply green Tithonia or Mexican marigold (Tagetes spp.)</li> </ul> <p><b>Bio-control</b></p> <ul style="list-style-type: none"> <li>• Drench the plants using Azadirachtin (Achook, Neem cake, Nematon or Nimbecidine at the rate of 600 ml/20l )</li> </ul>
<p>Justification</p>	<p>Nematodes cause considerable reduction in yield and lower the seed (pod) quality. Where the nematode is severe and not controlled plants become greatly reduced in size and yield. Losses of above 20-60% are experienced due to the pest under high infestation levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic pesticides in their control. Integrated Management of pests considering food safety concerns should be highly advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<p><b>B: Assessment of dissemination and scaling up approaches</b></p>	
<p>Users of TIMP</p>	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's</p>
<p>Approaches used in dissemination</p>	<ul style="list-style-type: none"> <li>• On-farm trials and Demonstrations</li> <li>• ASK shows</li> <li>• Field days</li> </ul>

	<ul style="list-style-type: none"> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> <li>• Print media brochures</li> </ul> <p>Conferences and journals</p>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on insects</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage Insects</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
<p>Partners/stakeholders for scaling up</p>	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in insect management</li> <li>• PCPB to promote registration of insecticides for insect management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> </ul>


	<ul style="list-style-type: none"> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMP will be upscaled	Counties with high potential for upscaling; Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on insect pests infesting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in insect management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the insects</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the insect management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.35,500</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 60%. Therefore, the estimated returns will be 380,000-228,000= <b>Ksh.152,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	-The Molo potato garden pea farm harvesting millions tons of garden peas -What it takes to produce food for global market; Daily Nation: 16 January 2015
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>

<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:frc.muguga@kalro.org">frc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO: Miriam Otipa., Nyaga A., Otipa M., Amata R., Gatambia E., Kuria S., Ndegwa, A., Ndubi, J., MMUST, <sup>2</sup> Ogemah, V. <b>CABI:</b> Duncan Chacha</p>
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

### Research Gaps

- Capacity building on Nematode identification and management
- Validation of biopesticides and synthetic pesticides in the management of garden pea nematodes
- Determine the effects of major nematodes on garden pea yield, quality and implication on economic returns for the farmer

<b>2.6.8 TIMPs name</b>	<b>Integrated Management of Pea wilt (<i>Fusarium oxysporum f. sp. pisi</i>)</b>
	 <p>Pea Diseases <b>Source:</b> Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practice


<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yield losses of up to 100%
What is it? (TIMP description)	<p>Integrated management of pea wilt consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Rouging of diseased plants</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Apply fungicides during new leaves flush, bud formation or at flowering.</li> <li>• Use fungicides such as sulphur based fungicides e.g., Thiovet jet WP, Trifloxystrobin + Tebuconazole based fungicides e.g Nativo 300 SC and Carbendazim based fungicides e.g. Rodazim SC.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>Fusarium wilt cause huge reduction in yield and lower the pod quality for garden pea. Where the wilt is severe and not controlled plants become greatly reduced in size and yield. Losses of 100% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
<p>Partners/stakeholders for scaling up</p>	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted, if any</p>	<p>Nakuru</p>

Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia, Muranga Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh. 23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 100%. Therefore, the estimated returns will be 380,000-380,000= <b>Ksh.0</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> </ul>

	<ul style="list-style-type: none"> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	-
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director</p>

	Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b>
Lead organization and scientists	KALRO Miriam Otipa., Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo Sylvia Kuria, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, FPEAK, Olivado Company


<b>2.6.9 TIMPs name</b>	<b>Integrated Management of Downy mildew (<i>Peronospora viciae</i>)</b>
	 <p><b>Source: <a href="https://plantvillage.psu.edu/topics/pea/infos">https://plantvillage.psu.edu/topics/pea/infos</a></b></p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Reduced crop yields of up to 60%
What is it? (TIMP description)	<p>Integrated management of downy mildew consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Rouging diseased plants</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p>

	<ul style="list-style-type: none"> <li>• Apply fungicides during new leaves flush, bud formation or at flowering.</li> <li>• Use fungicides such as sulphur based fungicides e.g., Thiovet jet WP, Trifloxystrobin + Tebuconazole based fungicides e.g. Nativo 300 SC and Carbendazim based fungicides e.g. Rodazim SC.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>Downy mildew cause huge reduction in yield and lower the pod quality for garden pea. Where the mildew is severe and not controlled plants become greatly reduced in size and yield. Losses of 60% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, seminars, meetings</li> <li>• Agricultural shows, field days, exhibitions</li> <li>• Farmer to farmer, Farmer research networks</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> </ul>

	<ul style="list-style-type: none"> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> </ul>

	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>•</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 60%. Therefore, the estimated returns will be 380,000-228,000= <b>Ksh.152,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories	<ul style="list-style-type: none"> <li>• The Molo potato garden pea farm harvesting millions</li> <li>• What it takes to produce food for global market; Daily Nation: 16 January 2015</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:frc.muguga@kalro.org">frc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO Miriam Otipa., Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo Sylvia Kuria, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua</p>
Partner organizations	MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

2.6.10 TIMP name	<b>Integrated Management of Leaf and pod spots (Ascochyta disease) (caused by <i>Ascochyta pisi</i>, <i>Mycosphaerella pinodes</i> and <i>Phoma medicaginis</i>)</b>
	 <p><b>Source:</b> Pea Diseases – Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields
What is it? (TIMP description)	<p>Integrated management of Leaf and Pod spot consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Rouging diseased plants</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Apply fungicides during new leaves flush, bud formation or at flowering.</li> <li>• Use fungicides such as sulphur based fungicides e.g., Thiovet jet WP, Trifloxystrobin + Tebuconazole based fungicides e.g. Nativo 300 SC and Carbendazim based fungicides e.g. Rodazim SC.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>Leaf spots cause huge reduction in yield and lower the pod quality for garden pea. Where the spots are severe and not controlled plants become greatly reduced in size and yield. Losses of 40% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control</p>

	and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up and roles	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
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**C: Current situation and future scaling up**

Counties where already promoted, if any	Nakuru
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Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu, Muranga and Laikipia Counties)
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Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
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Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
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Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>•</li> </ul>
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Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCBPB, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
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**D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations**

Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 40%. Therefore, the estimated returns will be 380,000-152,000= <b>Ksh.228,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	-The Molo potato garden pea farm harvesting millions -What it takes to produce food for global market; Daily Nation: 16 January 2015
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	

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Lead organization and scientists	<p>KALRO Antony Nyaga, Miriam Otipa., Robert Musyoki, Eliud Gatambia, Caesar Kambo ., Sylvia Kuria, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua</p>
Partner organizations	<p>MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company</p>

<b>2.6.11 TIMP name</b>	<b>Integrated Management of Botrytis, or grey mould (<i>Botrytis cinerea</i>)</b>
	 <p><b>Source:</b> Pea Diseases - Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields

<p>What is it? (TIMP description)</p>	<p>Integrated management of Botrytis consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Rouging diseased plants</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Apply fungicides during new leaves flush, bud formation or at flowering.</li> <li>• Use fungicides such as sulphur based fungicides e.g., Thiovet jet WP, Trifloxystrobin + Tebuconazole based fungicides e.g. Nativo 300 SC and Carbendazim based fungicides e.g. Rodazim SC.</li> <li>• Proper use of fungicide</li> </ul>
<p>Justification</p>	<p>Botrytis disease severe and not controlled, cause huge reduction in yield and lower the pod quality for garden pea. Losses of 20% are experienced under high infection levels. Quality of affected produce fetches low prices or is rejected in the market. Currently garden pea farmers use a in their control. Integrated Management of disease is the best bet for the disease control since it assures food safety and lowers reliance excessive use of synthetic fungicides. It involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option and in the recommended amounts. Adoption of an IPM approach minimizes overuse of synthetic pesticides and enhances food safety among the consumers while contributing to environmental safety.</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Farmers, Exporters, Processors, Extension service providers, Researchers, Academia</p>
<p>Approaches to be used in dissemination</p>	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> </ul>


	<ul style="list-style-type: none"> <li>Farmer field and business schools (FFBS)</li> <li>Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Support Agro chemical companies to sell biological controls products</li> <li>Create awareness of the benefits of the IPM management practices</li> <li>Willingness of stakeholders to participate</li> <li>Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>Create a platform for interaction of garden pea value chain stakeholders</li> <li>Farmers adopt appropriate agronomic practices</li> <li>Form well organized farmer groups and networks</li> <li>Formation of spray service providers (teams) to manage diseases</li> <li>A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>Extension agents (both private and public)</li> <li>Mobilization/sensitization of farmers and extension of the technology</li> <li>Farmers/CBO: participate in trainings and adoption of the technology</li> <li>KALRO to continually undertake research in disease management</li> <li>PCPB to promote registration of fungicides for disease management</li> <li>Universities to develop the technologies and conduct ToTs.</li> <li>Farmers/farmer groups to adopt the technologies</li> <li>County governments, central governments for development of enabling policies and create awareness.</li> <li>CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>Unwillingness of farmers to adopt IPM technologies</li> <li>In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>PCPB enhance registration of crop protection products</li> </ul>

	<ul style="list-style-type: none"> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>•</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 100%. Therefore, the estimated returns will be <b>380,000-380,000= Ksh.0</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>-The Molo potato garden pea farm harvesting millions          -What it takes to produce food for global market; Daily Nation: 16 January 2015</p>
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete,          Box 14733-00800, NAIROBI.          Tel: +254-020-2464435 Ext. 300          E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds;          P.O. Box 6223 01000 Thika:          Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>;          Telephone: +254-0727615868</p> <p>The Centre Director</p>

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Partner organizations	MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company


<b>2.6.12 TIMP name</b>	<b>Integrated Management of Powdery mildew (<i>Erysiphe pisi</i>)</b>
	 <p><b>Source:</b> Pea Diseases - Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practices
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields of up to 10-20%
What is it? (TIMP description)	<p>Integrated management of powdery mildew consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Pruning diseased twigs to improve air circulation</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Apply fungicides during new leaves flush, bud formation or at flowering.</li> </ul>

	<ul style="list-style-type: none"> <li>• Use fungicides such as sulphur based fungicides e.g., Thiovet jet WP, Trifloxystrobin + Tebuconazole based fungicides e.g Nativo 300 SC and Carbendazim based fungicides e.g. Rodazim SC.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>Powdery mildew cause huge reduction in yield and lower the pod quality for garden pea. Where the mildew is severe and not controlled plants become greatly reduced in size and yield. Losses of 20-70% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> </ul>

	<ul style="list-style-type: none"> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 20%. Therefore, the estimated returns will be <b>380,000-76,000= Ksh.304,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> </ul>

	<ul style="list-style-type: none"> <li>Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>The Molo potato garden pea farm harvesting millions of tonnes of peas</li> <li>What it takes to produce food for global market; Daily Nation: 16 January 2015</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>CABI-Plantwise Knowledge Bank</li> <li>Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>Garden Peas Diseases (Amata R., 2021)</li> <li>Garden Peas Pests (Amata R., 2021)</li> <li>Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	KALRO Antony Nyaga, Miriam Otipa., Robert Musyoki, Eliud Gatambia, Caesar Kambo Sylvia Kuria, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua
Partner organizations	MoA, Universities, ICRAF, CABI, KEPHIS, Olivado

2.6.13 TIMP name	<b>Integrated Management of Foot, root and stem rots (<i>Fusarium solani f. sp. pisi</i>, <i>Phoma medicaginis var. pinodella</i>)</b>
	 <p><b>Source:</b> <a href="http://pgro.org/pests-diseasea-peas">pgro.org/pests-diseasea-peas</a></p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields of up to 15-60%
What is it? (TIMP description)	<p>Integrated management of Foot, Root and Stem rot consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Pruning diseased twigs to improve air circulation</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Biological management:</b></p> <ul style="list-style-type: none"> <li>• Use of Trichoderma based biological control agents e.g rootgard, Trianum P and Trichotech</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Use of soft/safe cabendazim based products e.g Rodazim or Bendazim where the disease is severe and widely spread.</li> </ul>
Justification	Severe and uncontrolled root and stem rots cause huge reduction in yield, pod size and lower the pod quality for garden pea. Losses of up to 60% may be experienced making marketing of such produce to fetch low prices or be rejected. Currently garden pea farmers use a lot in their control. Integrated Management of the disease lowers use of synthetic fungicides, enhances food safety and protects our environment. It works through the use of a relatively safe combination of cultural and bio-control and biopesticides. Soft synthetic pesticides are recommended as a last option. Adoption of

	an IPM approach enhance food safety among the consumers and also contribute to environmental safety.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
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**C: Current situation and future scaling up**

Counties where already promoted, if any	Nakuru
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Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
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Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
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Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
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Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
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Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
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**D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations**

Basic costs	<b>Ksh.27,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 60%. Therefore, the estimated returns will be <b>380,000-228,000=Ksh. 152,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	The Molo potato garden pea farm harvesting millions tones of garden peas What it takes to produce food for global market; Daily Nation: 16 January 2015
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	

Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:ferc.muguga@kalro.org">ferc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO Miriam Otipa., Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo Sylvia Kuria, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua</p>
Partner organizations	<p>MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company</p>

<b>2.6.14 TIMP name</b>	<b>Integrated Management of Sclerotinia, or white mould</b> <i>(Sclerotinia sclerotiorum)</i>
	 <p><b>Source:</b> Pea Diseases - Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields
What is it? (TIMP description)	<p>Integrated management of sclerotinia consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> </ul>


	<ul style="list-style-type: none"> <li>• Pruning diseased twigs to improve air circulation</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Apply fungicides during new leaves flush, bud formation or at flowering.</li> <li>• Use fungicides such as sulphur based fungicides e.g., Thiovet jet WP, Trifloxystrobin + Tebuconazole based fungicides e.g Nativo 300 SC and Carbendazim based fungicides e.g. Rodazim SC.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>The Sclerotia diseases cause huge reduction in yield and lower the pod quality for garden pea. Where the rots are severe and not controlled plants become greatly reduced in size and yield. Losses of 20% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Exporters, Processors, Extension service providers, Researchers, Academia
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>

<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
<p>Partners/stakeholders for scaling up</p>	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted, if any</p>	<p>Nakuru</p>
<p>Counties where TIMP will be upscaled</p>	<p>Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu Muranga and Laikipia Counties)</p>
<p>Challenges in dissemination</p>	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>

Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>•</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 100%. Therefore, the estimated returns will be <b>380,000-380,000=Ksh. 0</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	The Molo potato garden pea farm harvesting millions What it takes to produce food for global market; Daily Nation: 16 January 2015
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
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Lead organization and scientists	KALRO Miriam Otipa., Sylvia Kuria, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua
Partner organizations	MoA, Universities and NGOs

<b>2.6.15 TIMP name</b>	<b>Integrated Management of Rhizoctonia seedling blight (<i>Rhizoctonia solani</i>)</b>
	 <p><b>Source:</b> Pea Diseases - Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practices
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields
What is it? (TIMP description)	<p>Integrated management of Foot, Root and Stem rot consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Pruning diseased twigs to improve air circulation</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Treat the seeds with Carbendazim + Thiram at 2 g/kg or pellet the seeds with Trichoderma viride at 4 g/kg or Pseudonomas fluorescens @ 10g/kg of seed.</li> </ul>


	<ul style="list-style-type: none"> <li>• Apply farm yard manure or green leaf manure (<i>Gliricidia maculate</i>) at 10 t/ha or neem cake at 150 kg/ha.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>Rizoctonia root rot cause huge reduction in yield and lower the pod quality for garden pea. Where the rots are severe and not controlled plants become greatly reduced in size and yield. Losses of up to 40% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> </ul>

	<ul style="list-style-type: none"> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000/=</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 40%. Therefore, the estimated returns will be <b>380,000-152,000= Ksh.228,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories	<ul style="list-style-type: none"> <li>• The Molo potato garden pea farm harvesting millions of tons of peas</li> <li>• What it takes to produce food for global market; Daily Nation: 16 January 2015</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	KALRO Miriam Otipa., Sylvia Kuria, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua
Partner organizations	MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

<b>2.6.16 TIMP name</b>	<b>Integrated Management of Septoria blotch (<i>Septoria pisi</i>)</b>
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	 <p><b>Source:</b> <a href="https://plantvillage.psu.edu/topics/pea/infos">https://plantvillage.psu.edu/topics/pea/infos</a></p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Low yields
What is it? (TIMP description)	<p>Integrated management of Septoria blotch consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Pruning diseased twigs to improve air circulation</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Treat the seeds with Carbendazim + Thiram at 2 g/kg or pellet the seeds with Trichoderma viride at 4 g/kg or Pseudonomas fluorescens @ 10g/kg of seed.</li> <li>• Apply farm yard manure or green leaf manure (Gliricidia maculate) at 10 t/ha or neem cake at 150 kg/ha.</li> <li>• Proper use of fungicide</li> </ul>
Justification	<p>Septoria leaf spot cause huge reduction in yield and lower the pod quality for garden pea. Where the spots are severe and not controlled plants become greatly reduced in size and yield. Losses of 40% is experienced due to the disease under high infection levels. Affected produce fetches low prices or is rejected. Integrated Management of the disease enhances food safety, lowers overuse of synthetic fungicides and protects the environment. It involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. Adoption of an IPM approach enhances food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches to be used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> </ul>

	<ul style="list-style-type: none"> <li>Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>Unwillingness of farmers to adopt IPM technologies</li> <li>Inadequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>PCPB enhance registration of crop protection products</li> <li>Training of stakeholders in IPM options</li> <li>Establish garden pea innovation platforms for technology disseminations</li> <li>Dissemination of integrated pest management practices and safe use of pesticides</li> <li>Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>Favorable environmental conditions</li> <li>Willingness of stakeholders to participate</li> <li>Favorable environmental conditions</li> <li>Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>Producers willing to adopt the disease management practices</li> <li>Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 40%. Therefore, the estimated returns will be <b>380,000-152,000=Ksh.228,000</b>

Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>The Molo potato garden pea farm harvesting millions of tones of garden peas  What it takes to produce food for global market; Daily Nation: 16 January 2015</p>
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete,  Box 14733-00800, NAIROBI.  Tel: +254-020-2464435 Ext. 300  E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds;</p>

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Lead organization and scientists	<p>KALRO  Miriam Otipa., Sylvia Kuria, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua</p>
Partner organizations	<p>MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company</p>

<b>2.6.17 TIMP name</b>	<b>Integrated Management of Bacterial blight (<i>Pseudomonas syringae</i> pv. <i>peisi</i>)</b>
	 <p><b>Scoures:</b> Pea Diseases - Vikaspedia</p>
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 due to disease
What is it (TIMP description)	<p>Integrated management of Bacterial blight consists of several approaches applied in an integrated manner to break the disease cycle. These include: cultural management and chemical control.</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Ensure that field sanitation and hygiene practices are adhered to by collecting and disposing infected pods, leaves, and twigs by burning or burying.</li> <li>• Pruning diseased twigs to improve air circulation</li> <li>• Ensure that the field is weeded to remove weeds</li> <li>• Use of resistant varieties</li> <li>• Practice crop rotation</li> <li>• Use clean seeds</li> </ul>

	<p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Proper use of fungicide</li> <li>• Use of various copper-based fungicides which are soft/safe synthetic pesticides</li> </ul>
Justification	<p>Bacteria blight cause huge reduction in yield and lower the pod quality for garden pea. Where the blight is severe and not controlled plants become greatly reduced in size and yield. Losses of 40% is experienced due to the disease under high infection levels. Marketing of such produce that is severely affected poses challenges and fetches low prices or is rejected. Currently garden pea farmers use a lot of synthetic fungicides in their control. Integrated Management of disease considering food safety concerns should be advocated considering that the vegetable is consumed very widely in Kenya. This involves the use of a combination of cultural and bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option. This minimizes overuse of synthetic pesticides. Adoption of an IPM approach would enhance food safety among the consumers and also contribute to environmental safety.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, seminars, meetings</li> <li>• Agricultural shows, field days</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> <li>• Mass media – Agricultural programmes</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> </ul>


	<ul style="list-style-type: none"> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> </ul> <p>Poor linkages among stakeholders in garden pea value chain</p>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> </ul>

	<ul style="list-style-type: none"> <li>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>Favorable environmental conditions</li> <li>Willingness of stakeholders to participate</li> <li>Favorable environmental conditions</li> <li>Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>Producers willing to adopt the disease management practices</li> <li>Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 40%. Therefore, the estimated returns will be <b>380,000-152,000= Ksh.228,000</b>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>Women have limited access to education, training and extension services than men</li> <li>Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Opportunities for youths exists in spraying the crop</li> <li>Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>VMGs have limited access to training and extension services</li> <li>Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities for unemployed exists in spraying the crop.</li> <li>Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>The Molo potato garden pea farm harvesting millions</li> <li>What it takes to produce food for global market; Daily Nation: 16 January 2015</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>CABI-Plantwise Knowledge Bank</li> </ul>

	<ul style="list-style-type: none"> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya. 2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>

<b>G: Contacts</b>	
Contacts	<p><b>Centre Director KALRO Kabete,</b> Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b> <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO Miriam Otipa., Sylvia Kuria, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua</p>
Partner organizations	MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company

<b>2.6.18 TIMP name</b>	<p><b>Integrated Management of viral diseases:</b></p> <ul style="list-style-type: none"> <li>• <b>Enation mosaic Virus Pea enation mosaic virus (PEMV)</b></li> <li>• <b>Red clover vein mosaic virus (RCVMV)</b></li> <li>• <b>Pea streak virus (PSV)</b></li> </ul>
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	 <p><b>Source:</b> Pea Diseases - Vikaspedia</p>
Category (i.e. technology, innovation or management practice)	Management practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	Yields losses due to viral diseases of up to 100%
What is it? (TIMP description)	<p>Integrated management of viral diseases of garden pea consists of various approaches that help to break the disease cycle. They include cultural management and chemical control. Viral diseases of garden pea are associated with insect infestations that transmit the pathogen while sucking sap from plant tissues. The diseases are effectively managed by controlling insect infestations</p> <p><b>Cultural practices:</b></p> <ul style="list-style-type: none"> <li>• Use of certified seed</li> <li>• Monitoring insect vectors that transmit the viruses</li> <li>• Avoiding work on fields when wet to prevent spread</li> <li>• Uprooting weeds that could serve as alternative hosts</li> <li>• Use of resistant varieties</li> </ul> <p><b>Chemical management:</b></p> <ul style="list-style-type: none"> <li>• Treat the seeds with Thiomethoxam-70WS or Imidacloprid-70WS @4g/kg • Spray Thiamethoxam-25WG @ 100g or Imidacloprid 17.8% SL @ 100 ml in 500 lit of water.</li> <li>• Get other control products from the PCPB (<a href="http://www.pcpb.or.ke">www.pcpb.or.ke</a>) list of registered pest control products, and use them according to the manufacturer's instructions.</li> </ul>
Justification	Integrated Disease Management is an environmentally friendly approach that enables the control of the disease through control of vectors and cultural practises that prevent on farm spread hence reducing yield loss.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Producers, Exporters, Farmers, Processors, Extension service providers, Researchers, Academia
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• On farm and on station research trails and demonstrations</li> <li>• Training workshops, Seminars, Meetings</li> <li>• Field days</li> <li>• Agricultural shows</li> <li>• Farmer research networks</li> <li>• Farmer to farmer</li> </ul>

	<ul style="list-style-type: none"> <li>• Mass media – Agricultural programs</li> <li>• Promotional materials (posters/brochures/leaflets, manuals)</li> <li>• Web material's</li> <li>• Digital platforms</li> <li>• Farmer field and business schools (FFBS)</li> <li>• Agricultural innovation platforms</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Support Agro chemical companies to sell biological controls products</li> <li>• Create awareness of the benefits of the IPM management practices</li> <li>• Willingness of stakeholders to participate</li> <li>• Carry out Applied and adaptive research to validate IPM technologies on diseases</li> <li>• Create a platform for interaction of garden pea value chain stakeholders</li> <li>• Farmers adopt appropriate agronomic practices</li> <li>• Form well organized farmer groups and networks</li> <li>• Formation of spray service providers (teams) to manage diseases</li> <li>• A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.</li> </ul>
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> <li>• Extension agents (both private and public):</li> <li>• Mobilization/sensitization of farmers and extension of the technology</li> <li>• Farmers/CBO: participate in trainings and adoption of the technology</li> <li>• KALRO to continually undertake research in disease management</li> <li>• PCPB to promote registration of fungicides for disease management</li> <li>• Universities to develop the technologies and conduct ToTs.</li> <li>• Farmers/farmer groups to adopt the technologies</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer.</li> <li>• Financial institutions to provide credit facilities</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted, if any	Nakuru
Counties where TIMP will be upscaled	Nyandarua (Other counties with high potential include Kiambu, Nyandarua, Nakuru, Uasin Gishu and Laikipia Counties)







Challenges in dissemination	<ul style="list-style-type: none"> <li>• Unwillingness of farmers to adopt IPM technologies</li> <li>• In adequate knowledge on IPM strategies on diseases infecting garden pea and losses attributed to them</li> <li>• Poor linkages among stakeholders in garden pea value chain</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• PCPB enhance registration of crop protection products</li> <li>• Training of stakeholders in IPM options</li> <li>• Establish garden pea innovation platforms for technology disseminations</li> <li>• Dissemination of integrated pest management practices and safe use of pesticides</li> <li>• Promote appropriate marketing channels e.g. contract farming, collective production and marketing</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Sensitization is necessary for people to appreciate the use of IPM in disease management</li> <li>• Adoption of good agricultural practices by farmers is key in management of the diseases</li> <li>• Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Favorable environmental conditions</li> <li>• Willingness of stakeholders to participate</li> <li>• Favorable environmental conditions</li> <li>• Regulatory bodies e.g. PCPBP, KBS to ensure fungicides sold to farmers are genuine and of high quality</li> <li>• Producers willing to adopt the disease management practices</li> <li>• Producers are organized in groups to ensure that management practices are effectively up-scaled</li> <li>• Farm input costs are within the reach of farmers</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<b>Ksh.23,000</b>
Estimated returns	If the farmer doesn't practice IPM the yield will be reduced by 100%. Therefore, the estimated returns will be <b>380,000-380,000=Ksh. 0</b>
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men</li> <li>• Women have limited access to education, training and extension services than men</li> <li>• Women have less access to agricultural information, technology and knowledge</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exists in spraying the crop</li> </ul>

	<ul style="list-style-type: none"> <li>• Affirmative action funds exist for youths and women to access the required funds.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to buy the required inputs such as chemicals</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for unemployed exists in spraying the crop.</li> <li>• Affirmative action funds exist for youths to access the required funds.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<p>-The Molo potato garden pea farm harvesting millions of tonnes of garden peas</p> <p>-What it takes to produce food for global market; Daily Nation: 16 January 2015</p>
Application guidelines for users	<ul style="list-style-type: none"> <li>• CABI-Plantwise Knowledge Bank</li> <li>• Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.</li> <li>• Garden Peas Diseases (Amata R., 2021)</li> <li>• Garden Peas Pests (Amata R., 2021)</li> <li>• Infonet.biovision.org</li> </ul>
<b>F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research</b>	<b>Ready for up scaling</b>
<b>G: Contacts</b>	
Contacts	<p><b>Centre Director</b> KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a></p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: <a href="mailto:info.ptc@kalro.org">info.ptc@kalro.org</a>; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South</p>

	<p>P. O. Box 30148-00100,  Nairobi, Kenya.  <b>Email: <a href="mailto:fcrc.muguga@kalro.org">fcrc.muguga@kalro.org</a></b>  <b>Tel: +254-0722219075</b></p>
Lead organization and scientists	<p>KALRO  Miriam Otipa., Sylvia Kuria, Antony Nyaga, Robert Musyoki, Eliud Gatambia, Caesar Kambo, Lusike Wasilwa Ruth Amata, Vitalis Ogemah and Violet Kirigua</p>
Partner organizations	<p>MoA, Universities ICRAF, CABI, KEPHIS, FPEAK, Olivado Company</p>

## Weed Management in Garden pea

<b>2.6.19 TIMP Name</b>	<b>Integrated Weed Management in Garden Pea</b>
Crop management practices	Management practices
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High incidence of difficulty to control annual and perennial grass and broadleaved weed species infestation, limited knowledge on weed identification, combined with inappropriate, inefficient and unsustainable methods used to control lead to low and poor quality yields
What is it? (TIMP description)	<p>Integrated weed management (IWM) is the management of weeds using several weed approaches such as preventive, physical control, biological control, mulching, cultural, mechanical and chemical control.</p> <p><b>Physical control</b> is manual or mechanical removal of weeds by hand weeding or mowing. <b>Biological control</b> is where animals graze on the weeds. <b>Chemical control</b> is where appropriate herbicides are applied to control weeds. <b>Cultural control</b> includes crop rotation since various crops may influence the diversity and abundance of particular weeds. <b>Mechanical weed management</b> includes use of farm equipment such as hoes, slashers and a motorized knap weeder which does the work much faster and is less tedious. <b>Chemical weed management</b> involves use of pre-emergence selective and non selective herbicides and or post- emergence selective and non selective herbicides. In manual weeding farmers carry out first weeding at 2-3 weeks after germination and second weeding just before flowering (about 4-6 weeks).</p>
Justification	Weeds, a major challenge in garden pea production, do not only compete for growth resources such as nutrients with the crops but also harbor insect pests and create conducive environments for diseases. Huge yield losses in garden pea are attributed to poor weed management. Proper weed management leads to higher yields in garden pea. Some of the common broad leaved weeds in garden pea production include; black jack, gallant soldier, mexican marigold, and wandering jew. Grass weeds include couch, kikuyu and star grass. Different weeds may require different strategies for effective control because one approach will be effective on some species and not others, hence the need to combine various management strategies.


			
	<b>Mexican marigold</b> <i>(Tagetes minuta)</i>	<b>Gallant soldier</b>	<b>Black jack (<i>Bidens pilosa</i>)</b>
			
	Purslane ( <i>Portulaca oleracea</i> )	Couch grass ( <i>Cynodon dactylon</i> )	Yellow sedge ( <i>Cyperus esculentus</i> )
<p>Majority of farmers in Kenya use manual approaches for weed management which is effective but it is time consuming and labour intensive. It can also be ineffective when weeding is done in wet conditions due to immediate regrowth of the weeds.</p> <p>Farmers who have used pre- emergence (within 24hrs after planting) and post emergence (at 2-4 leaves) have realized higher yields than manual weeding. Use of herbicides is effective, time and labour saving. There are several registered herbicides (Pest Control Products Board (PCPB) List of registered products) in the market that can be used in garden pea. Post emergent herbicides such as Agil 100 EC applied in between rows 2-3 weeks after emergence at a rate of 100-200mls in 20 liters of water controls existing and actively growing weeds in garden pea. Pre-emergent herbicides such as LinuronWP when applied at a rate of 60-80g in 20 liters of water on the soil within 24 hours hours after planting will prevent germination of broad leaved weeds in the crop.</p>			
<b>B: Assessment of dissemination and scaling up/out approaches</b>			
Users of TIMP	Farmers, Extension workers, Agro dealers		
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Demonstrations and field days.</li> <li>• Media (Online)</li> <li>• Manuals, pamphlets.</li> </ul>		

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Promote integrated weed management</li> <li>• Address environmental and safety concerns related to the use of herbicides</li> <li>• Accompany the promotion with demos and field days with farmers groups and stakeholders on the effectiveness of the various weed management options using FFSB approach.</li> <li>• Train users on appropriate use of herbicide and safe use. Train people on biology of weeds and weed dynamics in cropping systems.</li> <li>• Farmers need training on timing with regard to conservation of biodiversity. Preserve pollinators for increased productivity of weed control.</li> </ul>
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> <li>• Agrochemical companies</li> <li>• Research partners (KALRO, CIAT), County extension staffs, NGOs</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Central Kenya
Counties where TIMPs will be up scaled	Selected regions growing garden pea
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Scarcity and high labour costs</li> <li>• High cost of herbicides</li> <li>• Inadequate knowledge and information on which herbicides to use and when to use them</li> <li>• Myths on appropriateness of using herbicides</li> </ul>
Suggestion for addressing the challenges	<ul style="list-style-type: none"> <li>• Promotion of IWM through demos and field days</li> <li>• Involvement of the stakeholder e.g. agro-chemical company, farmer groups</li> <li>• Development and dissemination of information to various stakeholders</li> <li>• Training on various integrated approaches including appropriate herbicides and their safe.</li> </ul>
Lesson learned in up scaling if any	<ul style="list-style-type: none"> <li>• That integrated approaches of weed management are more effective than use of one control method.</li> <li>• Continued use of herbicide is environmental, health and social hazard and thus safe use is a requirement.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Training on the understanding and working of an IWM approach.</li> <li>• Have an environmental and safety plan when using herbicides</li> <li>• Address the environmental and social concerns related to use of agrochemicals.</li> <li>• A functional agrodealer network to supply the products when required by the farmers</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Ksh 8,000 per acre
Estimated returns	KSH 100,000 per acre
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• IWM is labor intensive in terms of handling and application hence may not be adopted by women who are already overburdened.</li> <li>• Women and youth have limited access to land than men.</li> <li>• Women and youth may also have limited access to inputs such as manures and chemicals than men.</li> <li>• Women have less access to agricultural information, technology and knowledge than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunity exist for women to access the required credit through the women enterprise funds.</li> <li>• Employment opportunities exist for youths in spraying the weeds</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land than men.</li> <li>• VMGs may also have limited access to finances to buy the required inputs such as manures and chemicals than men.</li> <li>• VMGs have less access to agricultural information, technology and knowledge than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunity exist for youths to access the required credit through the youths enterprise funds.</li> <li>• Employment opportunities exist for youths in spraying the weeds</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	Extension and training material available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO, Kabete Dr Hottensiah Mwangi, Dr. Violet Momanyi, Dr Jedidah M. Maina, Charity, W. Muchira, Caesar Kambo, Antony Nyaga, Eliud Gatambia, Sylvia Kuria, Ruth Amata
Partner organizations	Kenya Seed Company, Faida Seed, NGOs, CBOs, County Governments, KEPHIS

### Research Gaps:

Determine cost benefits of using motorized knap weeder versus other weed management strategies in garden pea production

<p><b>2.6.20 TIMP Name</b></p> <p>Categories (i.e. technology innovation Or management practice)</p>	<p><b>Intercropping System in garden pea</b></p> <p>Innovation</p>
<p><b>A: Description of the technology, innovation or management practice</b></p>	
<p>Problem to be addressed</p>	<p>Diversity of annual and perennial grass and broadleaved weed species infestation and poor control measures in garden pea crop leading to low and poor quality yield.</p>  <p><b>Garden pea intercropped with</b></p>
<p>What is it? (TIMP description)</p>	<p>This is the growing garden pea with two or more crops in a field at the same time with an aim to enhance production and to obtain efficient land use by reducing the weedy area between rows. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. These include mixed, strip, row, Relay and Alley intercropping systems. The MBILI-MBILI intercropping systems results in same plant population and fertilizer input as Conventional Intercropping. The production of garden pea and other legumes in MBILI-MBILI system is higher than the production of legumes in the usual farmers planting arrangement.</p>
<p>Justification</p>	<p>Intercrops in middle rows of garden pea can provide weed control inbetween rows through weeding which reduces weed establishment and population in the field. Intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. Garden pea</p>

	intercrop can benefit up to 35-60 % as compared to planting garden pea alone. Poor intercropping results in low yields attributed to competition for growth resources such as nutrients and may lead to reduced yield. Garden pea does well when intercropped with other crops such as garden pea to mitigate the risk of total crop failure. Intercropping that controls weeds and increases production requires use of the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing competition, the right variety of crop depending on growth habit of the intercrop. Poor intercropping results in low yields attributed to competition for growth resources.
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### **B: Assessment of dissemination and scaling up/out approaches**

Users of TIMP	Farmers, Extension Staff
Approaches used in dissemination	Demos, FFSs and field days, demonstrations on larger plots
Critical/essential factors for successful promotion	Conduct demos and the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	County extension staff, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN, CIAT-PABRA)

### **C: Current situation and future scaling up**

Counties where already promoted if any	Central Kenya
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Counties where TIMPs will be up scaled	Selected regions growing garden pea
Challenges in development and dissemination	Inadequate training and limited extension staff
Suggestion for addressing the challenges	<ul style="list-style-type: none"> <li>• Facilitation of training of county extension staffs</li> <li>• Contact demos and field days</li> </ul>
Lesson learned in up scaling if any	<ul style="list-style-type: none"> <li>• Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits.</li> <li>• There is need to adapt the technology when promotes in new environments/AEZ</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	A farmer learning platform is essential for training on how to deploy the technology

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

Basic costs	-Not determined
Estimated returns	Not determined

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Complexity of the intercropping system may result in increased labour for women who perform most of the crop's activities such as planting and weeding.</li> <li>• Women have less access to information, technology and knowledge.</li> <li>• Women have less access to land and credit that can be used for garden peas farming than men.</li> <li>• Women have limited access to education, training and extension services than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Intercropping offers good opportunities women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits.</li> <li>• Affirmative action opportunities such as the women enterprise funds and youth fund exists to access the required credit.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge.</li> <li>• VMGs have limited access to productive resources such as land and credit for garden peas farming.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Intercropping offers good opportunities to VMGs to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits.</li> <li>• Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	Extension and training material available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
<b>G: Contacts</b>	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO: Dr Hottensiah Mwangi, Dr. Violet Momanyi, Dr Jedidah M. Maina, Charity, W. Muchira, Caesar Kambo, Antony Nyaga, Eliud Gatambia, Sylvia Kuria, Ruth Amata
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

<b>TIMP name</b>	<b>Mulching to control weed in garden pea</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	High weed seed bank in the soil of difficulty to control annual and perennial grass and broadleaved weed species infestation, limited knowledge on weed identification, combined with inappropriate, inefficient and unsustainable methods used to control lead to low and poor quality yields.
What is it? (TIMP description)	The practice of covering the soil/ ground with natural or synthetic materials to effectively control germination of weed seeds in or at the soil surface using biodegradable or natural mulches. Biodegradable mulches include straw, grass and dead leaves. Organic mulches (garden pea stovers commonly used) should be between 2-4 inches deep to effectively prevent weed germination and suppress the growth in garden pea fields. In addition, organic mulches retain moisture in the soil; keep the soil cool; and help improve soil fertility and improve microclimate when they decompose. Synthetic mulches will solarize soils, suppress weed growth, prevent seed germination and retain soil moisture. Inspect and pull out emerging weeds timely. Only black sheets should be used to mulch.
Justification	Black polythene prevents weed seed germination and light from reaching the small weeds which then become weak and die. In addition to minimizing weed infestation organic mulches (such as straws and dry grass) facilitate retention of soil moisture there by controlling temperature fluctuations, improves physical, chemical and biological properties of soil by adding nutrients to the soil which enhances the growth and yield of garden pea. It also improves soil structure directly by preventing impact of raindrop (soil erosion) and indirectly by promoting biological activity. Although a common farmer may not afford, synthetic mulches are easy to obtain and apply, and are reusable.
<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>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Farmer field Business schools</li> <li>• On-farm demonstrations during farmer field days</li> <li>• Training in workshops</li> </ul>

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release mulching technology in garden pea varieties</li> <li>• A platform for interaction of garden pea value chain stakeholders</li> <li>• Availability of plant or crop residues for organic mulches.</li> <li>• Size of the land.</li> <li>• Competing uses of crop residues.</li> <li>• Type and availability of the crop residues</li> <li>• Cost and availability of synthetic materials</li> <li>• Disposal of synthetic material after use.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO to provide Research services</li> <li>• County governments and MoALF@L to provide extension services, farmer mobilization and policy formulation</li> <li>• NGOs to provide micro financing services</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Synthetic mulches are rarely used in Kenya.
Counties where TIMP will be promoted	Where garden Pea is a priority value chain. All the other 17 counties
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of garden pea innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the agronomic practice</li> <li>• Labour intensity and availability of mulching materials</li> <li>• Lack of enough plant and crop residues due to competing uses of organic mulches.</li> <li>• Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches. Be aware of small tears and rips which will allow weeds to emergence through plastic mulches including around the holes. The nutsedges and oxalis may penetrate mulches as early as six days after mulching..</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish garden pea innovation platforms</li> <li>• Crop diversification to increase availability of organic mulches.</li> <li>• Establish and follow a good integrated weed management control program for the particular garden pea varieties.</li> <li>• Monitor for any tears /rips and pull out any weeds without allowing them to take over.</li> <li>• Adapting alternative mulching materials like high absorbance polymers.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology/ IWM</li> </ul>



	<ul style="list-style-type: none"> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• There is need to adapt to alternative mulching technologies such as use of a black polythene in addition to organic materials like straws dry leaves, and dry grass.</li> <li>• Mulching in garden pea is environmentally friendly</li> </ul>
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> <li>• Practice is socially acceptable and environmentally friendly</li> <li>• Increased productivity will provide supply to the markets</li> <li>• Supporting frameworks/policies are available.</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	Dependent on value chain but generally >100% of the initial investments assuming other factors are in control.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Mulching will reduce women's weeding time that can be used in performing other productive activities.</li> <li>• Mulching may be labor intensive for some women who are already overburdened by other domestic activities hence may not to be adopted.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the unemployed youths in performing the operation.</li> <li>• Opportunities exist for women to use the readily available on-farm mulch, to enrich their crop for increased productivity.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Mulching will reduce some VMGs weeding time that can be used in performing other productive activities.</li> <li>• Mulching may be labour intensive for some VMGs such as the elderly hence may not to be adopted.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for the unemployed youths in performing the operation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers in different value chains have reported increased crop production following application of mulching technology, improved soil conditions, reduced runoff and nutrient loss and soil moisture retention in the soil.

Application guidelines for users	<ol style="list-style-type: none"> <li>1. Plant clean garden pea seeds.</li> <li>2. Apply mulch between the rows of garden pea</li> </ol> <p><b>Mulch management</b> Pull or kill weeds that grow out of the mulch.</p> <p>The Kenya Cereals Enhancement Programme - Climate Resilient Agricultural Livelihoods (KCEP-CRAL). Garden pea Extension Manual. <a href="https://www.kalro.org/files/kcep/Green-grams-18.6.21">https://www.kalro.org/files/kcep/Green-grams-18.6.21</a>.</p>
<b>F: Status of TIMP readiness</b> (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	<ol style="list-style-type: none"> <li>1. Ready for upscaling</li> <li>2. Requires validation</li> </ol>
<b>G: Contacts</b>	
Contacts	<b>Centre Director</b> KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. <u>Tel:+254-0721822312</u> E-mail: <a href="mailto:cd.narl@kalro.org">cd.narl@kalro.org</a>
Lead organization and scientists	KALRO: Dr Violet Momanyi , Dr Hottensiah Mwangi
Partner organizations	County governments Public-Private-Partnerships

Research Gaps:

Determine cost benefits of using synthetic plastic mulch versus other weed management strategies in garden pea production

<b>2.6.21 TIMP Name</b>	<b>Chemical Weed Control</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High incidence of difficulty to control annual and perennial grass and broadleaved weed species infestation, limited knowledge on weed identification, combined with inappropriate, inefficient and unsustainable methods used to control lead to low and poor quality yields.

<p>What is it? (TIMP description)</p>	<p>Chemical weed control is a technology used to control the germination and growth of the weed species through application of chemicals/ herbicides to weeds or the soil. Herbicide weed control is a technology that requires knowledge on herbicides required for specific crops.</p> <div style="display: flex; justify-content: space-around;">   </div> <p><i>Pre-emergent herbicide application on the soil</i> Source: Hottensiah Mwangi</p> <p><i>Applying to kill weeds after tillage and prevent seed germination</i> Source: Violet Momanyi</p> <p>Some recommended herbicides include:</p> <ol style="list-style-type: none"> <li>1. Lasso 50% EC @ 170-200mls in 20 liters of water</li> <li>2. Agil 100EC @ 100-200ml in 20 liters of water, will control grass weeds in garden pea</li> </ol>
<p>Justification</p>	<p>Manual hand weeding is very labour intensive, scarce and expensive. Use of herbicides reduces drudgery and weed control is timely. This prevents competition with garden pea leading to high yields</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Farmers and extension agencies</p>
<p>Approaches used in dissemination</p>	<ul style="list-style-type: none"> <li>• On-farm experimentation and dissemination</li> <li>• Field days, shows, farmer to farmer communication, leaflets,</li> <li>• Demonstrations on larger plots</li> <li>• Training and creating awareness</li> </ul>
<p>Most effective approach</p>	<p>On-farm experimentation and demonstrations on larger plots.</p>
<p>Critical/essential factors for successful promotion</p>	<p>Capacity building and training on safe use of chemicals for all users</p>

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –(MOALF&amp;I) for extension,</li> <li>• Chemical companies for back stopping</li> <li>• ICRISAT for technical backstopping and promotion;</li> <li>• FIPs (Farmer Input Promotion) for promotion</li> <li>• Farmer Groups for activity implementation and promotion</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kiambu, Machakos, Kitui
Counties where TIMP will be scaled up	Nyandarua, Meru
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited knowledge, information and low literacy levels among the farmers.</li> <li>• Herbicide use and application requires knowledge and training on safe and responsible use of herbicides.</li> <li>• The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish garden pea innovation platforms</li> <li>• There is need to train the agricultural extension county officers as TOTs on appropriate use of herbicides. This will help in reaching the farmers with the information.</li> <li>• Herbicides like all chemicals have to be used with care to avoid environmental, health and social hazards.</li> <li>• Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on safe use of herbicides.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology-chemical weed control</li> <li>• Consumers concerns of herbicide residues in the soil and subsequent crops needs attention</li> <li>• Availability of market is essential</li> </ul>


	<ul style="list-style-type: none"> <li>Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>Access to and use of information on different weed control methods will reduce labour and cost of weed management. It could give room to increase area under cultivation and increase productivity.</li> </ul>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and safe use of chemicals is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KSH 10,000.
Estimated returns	KSH 110,000
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>Women perform most of the weeding activities therefore the TIMP will reduce their work burden.</li> <li>Women and youth have limited access to productive resources such as land and chemicals.</li> <li>Women and youth have limited access to education, training and extension services than men.</li> <li>Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Employment opportunities exist for youth males and men in spraying.</li> </ul>
VMGs issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>VMGs have limited access to productive resources such as land, credit and chemicals.</li> <li>Women and youth have limited access to education, training and extension services than men.</li> <li>Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>There is low adoption by VMGs due lack of awareness.</li> </ul>
VMGs related opportunities	<ul style="list-style-type: none"> <li>Employment opportunities exist for youth males and men in spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Siaya, Makueni, Kitui but in other crop value chain.
Application guidelines for users	<ol style="list-style-type: none"> <li>Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.</li> <li>Rational use of herbicides. Eco friendly Weed Control options for Sustainable Agriculture. Science Alert. Review article. Scialert.net/fulltext/?</li> <li>Herbicides. NORTH CALORINA STATE EXTENSION. &lt;<a href="https://content.ces.ncsu.edu">Https//content.ces.ncsu.edu</a>&gt;</li> </ol>

	4. Bararpour T, Hale R, Gurpreet K, Singh B, Tseng MT, Wilkerson MT and Willett DC. (2019). Weed Management Programs in Grain Garden pea (Garden pea bicolor). Agriculture, 9(8):182. <a href="https://www.researchgate.net/publication/335236855">https://www.researchgate.net/publication/335236855</a> . 5. Weed control leaflets/ manuals.
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research)	2. Requires validation 3. Requires further research
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: <a href="mailto:cdnarl@kalro.org">cdnarl@kalro.org</a>
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	ICRISAT Nairobi; MoALF in Counties, Chemical companies

#### Research Gaps:

Determine cost benefits of using synthetic chemicals versus other weed management strategies in garden pea production

<b>2.6.22 TIMP Name</b>	<b>Mechanical weeding for weed management</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem addressed	High incidence of difficult to control annual and perennial grass and broadleaved weed species infestation, limited knowledge on weed identification, combined with inappropriate, inefficient and unsustainable methods used to control lead to low and poor quality yields.
Whatisit?(TIMP description)	Mechanical/ manual weed control is a technique that manages weed populations through physical methods that remove, injure, kill, or make the growing conditions unfavourable for growth using tools such as pangas, jembes and slashers. Some of the methods cause direct damage to the weeds through complete removal or causing a lethal injury. Other techniques may alter the growing environment by eliminating light, increasing the temperature of the soil, or depriving the plant of carbon dioxide or oxygen. Mechanical control can be either selective or non-selective. A selective method has very little impact on non-target plants where as a non-selective method affects the entire area that


	<p>is being treated. Land is prepared well using hand tools to get a weed free seedbed. Sowing is done in rows to facilitate inter- row weeding. Timely manual weeding is done 2-3 weeks after germination followed by a second weeding 2 to 3 weeks later depending on the rate of regrowth.</p>  <p><i>Clean seed bed prepared manually</i></p> <p>Delay in weeding may result into weed take over with leading to severe competition with the garden pea is avoided. The right tools for weeding are used to avoid shock-stress on garden pea due to disturbance and root damage because the young garden pea plant is very sensitive. The intra row weeds can also be removed by hand pulling.</p>
Justification	<p>If not controlled weeds will cause significant yield losses due to competition with the crop for nutrients and other growth factors. Weeds may also harbour other pests (insects and diseases) thereby lowering quality of the produce.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and Agricultural extension officers
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Most effective approach	On-farm experimentation and demonstrations on larger plots.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release improved mechanical weeding in garden pea varieties</li> <li>• A platform for interaction of Garden pea value chain stakeholders</li> <li>• Participatory Implementation, stakeholder sensitization.</li> </ul>

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –(MOALF&amp;I) for extension,</li> <li>• Jua Kali artisans</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Meru, Kiambu, Nyandarua
Counties where TIMP will be promoted	All counties growing Garden pea
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of garden pea innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Labour intensity</li> <li>• Low use of agronomic practices</li> <li>• Labour intensity</li> <li>• Appropriate implements such as sub-soilers are not readily available in the market.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish garden pea innovation platforms</li> <li>• Work with Jua Kali industries for production of appropriate implements such as sub-soilers.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technologies</li> <li>• Availability of market is essential is critical</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Access and use of appropriate weeding tools (technology) will provide timely weed control with reduced drudgery to enhance crop production.</li> </ul>
Social, environmental, policy and market conditions necessary	Sensitization of communities on the available technologies and management practices in weed management
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KSH 20,000 per acre.
Estimated returns	KSH 120,000/ per.

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the crops weeding activities therefore the TIMP will reduce their work burden</li> <li>• Women and youth have limited access to credit to purchase the required implement.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women in performing the operation.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to credit to purchase the implement.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• VMGs have limited access to information on production techniques. There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for women in performing the operation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Mechanical weed control is the common method used in garden peas farmers.
Application guidelines for users	ToT Manuals to include weed management TIMPs
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Validation 3. Requires further research)	1. Ready for up-scaling
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr. Violet Momanyi
Partner organizations	ICRISAT Nairobi; MoALF in Counties

#### Research Gaps:

Determine cost benefits of using mechanical weeding tools e.g knap weeder versus other weed management strategies in garden pea production

<b>2.6.23 TIMP Name</b>	<b>Solarization Bed for Weed Control in garden pea</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	A rich dormant seed bank of diverse annual and perennial grass and broadleaved weed species in the soil which germinate and compete with the crop for growth resources such as nutrients leading to yield losses.
What is it? (TIMP description)	<p>Solarisation is a method where transparent/ clear polythene films/ plastic is used to heat the soil and kill weed seedlings and dormant seeds in the top six inches of the soil. This increases soil temperatures by about 10<sup>0</sup>C or more than atmospheric. The basic phenomenon is building up of lethal high temperatures in the soil where most dormant and viable seeds are present.</p>  <p>Solarization of soil using transparent polythene film. Source: infonet-biovision.org</p> <p>The mechanism can increase soil temperature by 8-12 °C over non mulched soil which kills seeds and rhizomes of annual and perennial weeds if not deeply buried. Effectiveness depends on specific species and also the length of period of heating.</p>
Justification	Solarization for two consecutive years is successful in controlling perennial weeds. The Mechanism effectively breaks the dormancy of weed seeds, solar scotching of emerged weed seedlings and direct killing of weed seeds by heat. Solarization with 0.05mm T Polythene sheets for 40 days is effective in controlling weeds than use of 0.01mm polythene and takes shorter time duration. This is a good ecological and environmentally friendly method that is

	sustainable for small scale organic growers. If done properly, the use of post-emergent herbicides to control weeds is not necessary.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• On-farm experimentation and dissemination</li> <li>• Demonstrations on larger plots</li> <li>• Field days, shows, farmer to farmer communication, leaflets, training on how to use solarization.</li> </ul>
Most effective approach	On-farm experimentation and larger plot effect demonstrations.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release solarisation bed technology weed control in garden pea varieties</li> <li>• A platform for interaction of garden pea value chain stakeholders</li> <li>• Development of the agronomic practice for garden pea</li> <li>• Capacity building and training on use of polythene and solar power.</li> </ul>
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners (MOALF&amp;I) for extension,.</li> <li>• FIPs (Farmer Input Promotion) for promotion.</li> <li>• Farmer Groups for activity implementation and promotion.</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where are promoted if any	None
Counties where TIMP will be promoted	All counties growing Garden pea
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of garden pea innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the agronomic practice</li> <li>• Labour intensity</li> <li>• Limited knowledge and information and low literacy levels among the farmers.</li> <li>• Capacity building is required to impart knowledge and skills in appropriate use and application of solarization.</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers need to understand proper use and application of solarization to avoid buying inappropriate polythene and minimize health, environmental and social hazards.</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish garden pea innovation platforms</li> <li>• There is need to train the agricultural extension county officers as TOTs on appropriate use of solarization. This help in reaching the farmers with the information.</li> <li>• Polythene disposal should be done carefully to avoid environmental, health and social hazards.</li> <li>• Liaise with the Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on reuse and polythene disposal.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform.</li> <li>• Awareness creation through demonstrations and farmer field days help in adoption of the technology of Solarisation bed for weed control</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms. <ul style="list-style-type: none"> <li>• Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increased area under garden pea cultivation and increase productivity.</li> <li>• Solarization to control weeds is cheaper than manual weed control because it requires less labour and achieves timely weed management.</li> </ul> </li> </ul>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of transparent polythene is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KSH 20,000 per acre
Estimated returns	KSH 120,000
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> <li>• Women may have limited access to the required inputs such as the transparent plastic sheets.</li> <li>• Women have limited access to education, training and extension services on the TIMP than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities for youths exist in soil solarization through placement of transparent plastic sheets over the production bed.</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to education, training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• VMGs have limited access to the required inputs such as the transparent plastic sheets.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youths in performing the operation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	None
Application guidelines for users	<ul style="list-style-type: none"> <li>• Muhammad A.K.etal.,(2012). An approach to organic weed management. <i>J. Communications soil science and plant analysis.43:1847-60</i>. DOI:10.1080/DOI03624</li> <li>• Ali El Keblawy and Hamadi F.A (2009). Assessment of the differential response of weeds to soil solarization by two methods (2009). Research gate.net publications-230177258. <i>J. Weed biology and Management</i>.</li> <li>• Weed control leaflets/ manuals.</li> <li>• Information and instructions always displayed on the labels attached to container on how to use.</li> </ul>
<b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )	2. Requires validation 3. Requires further research
<b>G: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MoALF in Counties, Chemical companies.

<b>2.6.24 TIMP Name</b>	<b>Stale seed bed for Weed Control in garden pea</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	

Problem to be addressed	A weed management practice in which weed seeds just below the soil surface are allowed/ stimulated to germinate after rainfall or wetting the soil and then killed prior to planting the garden pea seeds while minimizing soil disturbances. Weeds are killed using post-emergent herbicides such as glyphosate, sulfosate and glufosinate, or ploughed into the soil. At this stage shallow or use of non-residue paraquat may be used to destroy dense flush young weed seedlings. This is followed by sowing the selected garden pea. Several passes made in the soil with roto Spike tooth hallow is useful to destroy the emerging weeds during preparation of stale beds.
What is it? (TIMP description)	A rich dormant seed bank of diverse annual and perennial grass and broadleaved weeds in the soil which germinate and compete with the crop for growth resources such as nutrients causing yield losses.
Justification	The technology effectively controls broad and narrow leaved weeds that germinate and emerge before the crop is planted. Competition from weeds deprive green of available resources leading to weak and stunted growth in the young crop depending on weed density and diversity, stage of weed growth and environment. Grass weeds such as crab sanguinalis ( <i>Digitaria sanguinalis</i> ), goose grass ( <i>Eleusine indica</i> ) and couch grass which is difficult to control are killed after they germinate. Likewise broadleaved weeds such as amaranths species (eg Red pigweed ( <i>A. retroflexus</i> )), datura ( <i>Datura stramonium</i> ) and black jack ( <i>Bidens pilosa</i> ) are killed. Weeds whose control is difficult and challenging but can be validated by this technology include: the sedges, wandering jew ( <i>Commelina</i> species), parthenium and stiga species.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and extension agencies
Approaches used in dissemination	<ul style="list-style-type: none"> <li>• Farmer field and business Schools (FFBS)</li> <li>• Agricultural Innovation Platforms (AIP)</li> <li>• Training workshops, Seminars, Meetings</li> <li>• On-farm experimentation and dissemination, field days, shows</li> <li>• Farmer to farmer communication, leaflets, demonstrations on larger plot, training on how to use stale bed.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Applied and adaptive Research to test, validate and release stale seed bed for weed control in garden pea varieties</li> <li>• A platform for interaction of garden pea value chain stakeholders</li> <li>• Capacity building and training on use of polythene and stale bed</li> </ul>

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> <li>• Public and private partners –(MOALF&amp;I) for extension,</li> <li>• Chemical companies for back stopping.</li> <li>• FIPs (Farmer Input Promotion) for promotion.</li> <li>• Farmer Groups for activity implementation and promotion.</li> <li>• Service provider agencies e.g. Micro-finance agencies and banks for credit provision, agro-vets for input supply.</li> <li>• Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where are promoted if any	none
Counties where TIMP will be promoted	All Garden pea growing areas
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of garden pea innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Low use of the technology</li> <li>• Labour intensity</li> <li>• Limited knowledge and information and low literacy levels among the farmers.</li> <li>• Capacity building is required to impart knowledge and skills in safe use and application of stale beds.</li> <li>• The farmers need to understand the proper use of stale weed beds</li> </ul>
Recommendations for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish garden pea innovation platforms</li> <li>• There is need to train the agricultural extension county officers as TOTs on appropriate use of stale beds. This help in reaching the farmers with the information.</li> <li>• Agricultural extension and environmental officers on the ground for farmer empowerment and guidance on use of stale bed.</li> </ul>
Lessons learned	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technology- Stale seed bed</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> </ul>

	<ul style="list-style-type: none"> <li>• Consumers concerns of herbicide residues in the soil and subsequent crops needs attention</li> <li>• Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.</li> </ul>
Social, environmental, policy and market conditions necessary	Sensitization of communities on alternative methods of weed control and appropriate use of stale beds is very necessary.
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KSH 10,000 per acre
Estimated returns	KSH 100,000 per acre
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women perform most of the weeding activities therefore the TIMP will reduce their work burden.</li> <li>• Women and youth have limited access to resources such as land and chemicals.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in spraying the weeds using glyphosate and other chemicals.</li> </ul>
VMGs issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have limited access to productive resources such as land, credit and chemicals.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMGs related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in spraying the weeds using glyphosate and other chemicals.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	India. Not yet promoted in the country
Application guidelines for users	1. Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to container on how to use.

	<p>2. Guihua Chen and Cerruti RR Hooks (2021). The Stale Seedbed Technique: A Relatively Underused Alternative Weed Management Tactic for Vegetable Production. <a href="https://extension.umd.edu/resource">https://extension.umd.edu/resource</a></p>
<p><b>F: Status of TIMP Readiness</b> (1. Ready for up-scaling; 2. Requires validation; 3. Requires Research )</p>	<p>2. Requires validation 3. Requires further research</p>
<p><b>G: Contacts</b></p>	
<p>Contacts</p>	<p>KALRO Kabete P.O. Box 14733-00800, Nairobi Email: <a href="mailto:cdnarl@kalro.org">cdnarl@kalro.org</a></p>
<p>Lead organization and scientists</p>	<p>KALRO Dr Violet Momanyi, Dr Hottensiah Mwangi</p>
<p>Partner organizations</p>	<p>MoALF in Counties, Chemical companies.</p>

<p><b>2.6.25 TIMP Name</b></p>	<p><b>Safe Use of herbicides in garden pea production</b></p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p><b>A: Description of the technology, innovation or management practice</b></p>	
<p>Problem to be addressed</p>	<p>Excessive herbicide application to crops and the soil, use of herbicides for spraying crops without full protective clothing, storage of herbicides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, and use without following the guidelines provided on the labels (eg rate and Pre-Harvest Interval), disposal of expired herbicides and empty containers, inadequate enforcement of global and national policies and regulation on use of pesticides.</p>
<p>What is it? (TIMP description)</p>	<p>The technology includes methodologies for proper herbicide handling, application, and disposal of left overs and containers in order to minimize pollution of the environment and contamination of the produce. Capacity building of farmers, crop protection spray teams on safe handling and use of herbicides right from transportation from the agro-dealers to storage in their houses, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large.</p>
<p>Justification</p>	<p>Although cases of improper and misuse use of pesticides are very common in most of the areas where garden pea is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use</p>

	<p>of inappropriate spray equipment that lead to leakages and thereby exposing the operators to health risks as well as contamination of the water bodies. Most of these irregularities can easily be corrected through sensitization and capacity building forums for end users to be made aware of the best practices that should be used when handling herbicides. Increased chronic diseases in human beings resulting from pesticide exposure has been reported.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, garden pea producers
Approaches used in dissemination	<ul style="list-style-type: none"> <li>Farmer field and business Schools (FFBS)</li> <li>Agricultural Innovation Platforms (AIP)</li> <li>Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinics, Pesticides spray Demonstrations.</li> </ul>
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Applied and adaptive Research to test, validate and employ safe use herbicide application in garden pea varieties</li> <li>A platform for interaction of garden pea value chain stakeholders</li> <li>Development of agronomic practices for garden pea</li> <li>Collaboration between all partners, willingness of farmers to adhere to proper guidelines.</li> <li>Adequate facilitation: funds, logistics (transport)</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>Ministry of Agriculture-Extension Service to conduct extension services and farmer trainings, Individual Farmers, farmer groups/CBOs to participate in the implementation of the various technologies for garden pea production</li> <li>KALRO and Universities to develop the technologies and conduct ToTs. AAK, PCPB, KEPHIS.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where technology is already being promoted if any	Promoted in other crops in Siaya, Machakos, Makueni, Kiambu Counties
Counties where TIMPS will be up scaled	To be selected
Challenges in dissemination	<ul style="list-style-type: none"> <li>Lack of garden pea innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>Low use of technology</li> <li>Labour intensity and requires skilled man power</li> <li>Change of mindset in favour of current practices maybe difficult to achieve.</li> <li>Illiteracy and inadequate capacity to use herbicides correctly. Most farmers cannot read and interpret the</li> </ul>

	<p>labels properly resulting to overuse or underuse of herbicides.</p> <ul style="list-style-type: none"> <li>• Use of banned pesticides from neighboring countries</li> <li>• Inadequate capacity by farmers and agrochemical companies to dispose herbicides (pesticides) properly</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish garden pea innovation platforms</li> <li>• Capacity building and sensitization forums for both farmers and agro dealers using participatory approach.</li> <li>• Formation of youth spray teams.</li> <li>• Establishment of aggregation centres for pesticide containers</li> <li>• Establishment of training of Extension staff and lead farmers as TOT.</li> <li>• Increase surveillance along the border points and enforce the laws.</li> </ul>
Lessons learned in upscaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Creation of awareness through demonstrations and farmer field days help in adoption of the technologies</li> <li>• Availability of market is essential</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Consumers concerns of herbicide residues in the soil and subsequent crops needs attention</li> <li>• Upscaling of this technology needs young men and youth due to its hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collection and incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups.</li> <li>• The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of herbicides in some areas.</li> </ul>
Social, environmental, policy and market conditions necessary	Organized collective marketing channels critical for benefits to be derived from practice
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 10,000 per acre
Estimated returns	KES KSH 120,000 per acre
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to inputs such as chemicals.</li> <li>• Technology is not safe for use by expectant women and the physically challenged because of it hazardous/dangerous nature</li> </ul>


	<ul style="list-style-type: none"> <li>• Women have limited access to education, training and extension services than men.</li> <li>• Women have less access to agricultural information, technology and knowledge.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in spraying and also in operating agro chemicals that stock right pesticides as well as offering advisory services to farmers.</li> </ul>
VMGs issues and concerns in development and dissemination	<ul style="list-style-type: none"> <li>• VMGs have limited access to education, training and extension services.</li> <li>• Women have less access to inputs such as chemical.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMGs related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunities exist for youth males and men in spraying.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	<ul style="list-style-type: none"> <li>• The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people being exposed to herbicides.</li> <li>• Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction of these containers on farms.</li> <li>• Safe use of Pesticide campaigns by AAK, PCPB, KALRO and MOLF.</li> </ul>
Application guidelines for users	Manuals, brochures and fact sheets developed by KALRO and CABI as reference material
Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. requires further research)	1. Ready for upscaling
<b>F: Contacts</b>	
Contacts	KALRO Kabete P.O. Box 14733-00800, Nairobi Email: cdnarl@kalro.org
Lead organization and scientists	KALRO, Dr Violet Momanyi, Dr Hottensiah Mwangi
Partner organizations	MoALF&I, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

## 2.7 POSTHARVEST HANDLING

<b>2.7.1 TIMP Name</b>	<b>Sorting and Grading of Garden Peas</b>
Category (i.e. technology, innovation or management practice)	Management Practice
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Inferior quality and low prices from unsorted Garden Peas
What is it? (TIMP description)	Sorting is done to remove diseased, rotten Garden Peas, Garden Peas with nutrient deficiencies (e.g. yellowing spots), weeds and debris. Grading is categorization of Garden Peas according to pod and grain size, weight, maturity, turgidity, physical damage, and market demand.
Justification	Sorting helps to eliminate Garden Peas of poor quality and prevent cross contamination between spoilt and good Garden Peas. Garden Peas of superior quality fetch higher prices.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, exporters, processors, traders, extension workers, women and youth groups, households
Approaches used in dissemination	Training workshops, demonstrations, extension materials, field days
Critical/essential factors for successful promotion	Increasing awareness on the benefits of sorting and grading among value chain actors, postharvest trainers, well-organized farmer groups
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers groups to be trained in postharvest handling and value addition of the Garden Peas</li> <li>• Scientists and agricultural extension workers- to provide farmers with knowhow on vegetable postharvest handling</li> <li>• Green grocers and vegetable sellers – will provide markets for garden peas</li> <li>• Supermarkets and institutions (e.g. schools and hospitals) - will provide markets for Garden Peas</li> <li>• KEBS – to certify processors</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Vihiga, Busia, Kakamega, Nyeri, Muranga, Kiambu
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Kericho, Bomet, Meru, Embu, Kirinyaga, Laikipia, Kisii, Muranga, Kakamega, Vihiga
Challenges in dissemination	Lack of premium price for quality Garden Peas discourages farmers and traders to adopt the TIMP
Suggestions for addressing the challenges	Pay premium price to higher quality Garden Peas.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• There is a benefit to sort the peas at harvesting as there is value addition with increased returns and longer shelf lives.</li> </ul>

	<ul style="list-style-type: none"> <li>• Consistent trainings, demonstrations and sensitizations would motivate farmers to adopt the TIMP</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Enact policy to pay premium price to sorted and graded high quality produce.</li> <li>• Practice niche marketing for the different quality of produce</li> <li>• Favorable cool weather during harvesting period is desirable</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Low cost
Estimated returns	Sorting and grading translates to high quality, which fetches higher income.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge</li> <li>• Women have less access to land that can be used for garden peas farming than men</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women perform most of the crop's sorting activities.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for and women in sorting</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to land.</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for elderly and those who are disabled in sorting.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Garden Peas collection centers in Kiambu, Muranga, Nyeri, Meru, counties
Application guideline for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management Practices. KALRO / KCSAP project, February 2021.
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2- requires validation; 3-requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC; KALRO Kandara, KALRO Sericulture P.O. Box 220 - Thika

Lead organization and scientists	KALRO Francis Wayua, Antony Nyaga, Nasambu Okoko, Eliud Gatambia, Caesar Kambo and Sylvia Kuria
Partner organizations	KEBS, MoALF

<b>2.7.2 TIMP Name</b>	<b>Zero Energy Brick Cooler</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	High postharvest losses (30%) caused by lack of cooling technologies for Garden Peas
What is it? (TIMP description)	<p>The Zero Energy Brick Cooler consist of a double brick wall filled with sand in between, and a storage chamber. The sand is kept moist with water. The inside chamber is cooled through evaporation of the water in the sand.</p> 
Justification	Appropriate cooling reduces postharvest losses and extends shelf-life, hence the garden peas can be marketed and consumed over a long period and distances
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, green grocers, extension workers, women and youth groups, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials, exposure tours
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Use of locally available materials to construct the coolers</li> <li>• Funding to promote the coolers</li> <li>• Formation of marketing groups that would construct the coolers communally</li> <li>• County and Central Government support</li> <li>• Well organized farmer groups and networks</li> </ul>


Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers groups to be trained in postharvest handling of the Garden Peas</li> <li>• Scientists and agricultural extension workers- to provide farmers with knowledge on ZECC</li> <li>• Market players to create a demand and, therefore, increase area production</li> <li>• County governments, central governments for development of enabling policies and create awareness.</li> <li>• Financial institutions to provide credit facilitators</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Kirinyaga, Kiambu, Machakos
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Kericho, Bomet, Meru, Embu, Kirinyaga, Laikipia, Kisii, Muranga, Kakamega, Vihiga
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of knowledge on Zero Energy Brick Coolers</li> <li>• Lack of starter capital to construct the cooler</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation and capacity building about the technology to farmers and traders</li> <li>• Avail appropriate financing</li> </ul>
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on construction, repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• The sand should be continuously moist. Cooling is more effective in dry and windy environment</li> <li>• Ability of farmers to practice collective marketing of garden peas</li> <li>• Proper linkages between industry, farmer cooperatives, local and regional markets, and bulk purchases</li> <li>• Existing and new export markets are developed and maintained</li> <li>• Policies to encourage cold chain in horticulture sector are implemented.</li> <li>• Favourable policy, encouraging better prices for properly-preserved garden pea</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Low cost, approximately KES 100,000/-
Estimated returns	Reduced postharvest losses, increased income, nutrition
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge on the zero energy brick cooler technology</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women and youth have less access to credit to purchase the technology than men</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have less access to agricultural information, technology and knowledge on the the zero energy brick cooler technology</li> <li>Women and youth have less access to credit to purchase the technology than men</li> <li>VMGs have limited access to training and extension services.</li> <li>Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Fruit and vegetable farmers in Embu, Kirinyaga, Makueni, etc. have used the technology to reduce losses and extend shelf-life, hence the marketing time for the garden peas.
Application guideline for users	Wayua, F. Ndambuki, J., Ochieng, V. and Wasilwa, L. (2021). Zero Energy Cool Chamber. KALRO/KCSAP Programme Factsheet. September 2021
<b>F: Status of TIMP readiness</b> (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC; KALRO Kanadara, KALRO Sericulture P.O. Box 220 - Thika
Lead organization and scientists	KALRO Francis Wayua, Antony Nyaga, Nasambu Okoko, Eliud Gatambia, Caesar Kambo and Sylvia Kuria
Partner organizations	KEBS, MoALF

**GAPS:**

- Optimizing the storage conditions and keeping quality of the different garden peas.
- Validate the technology in difference AEZs.
- Research on innovative investment options for farmers and groups.

<b>2.7.3 TIMP Name</b>	<b>CoolBot™</b>
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Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	High postharvest losses due to lack of appropriate cooling technologies for garden peas
What is it? (TIMP description)	<p>It is a low cost postharvest temperature management that improved the shelf life of banana using less power The Coolbot™ is a small electrical device that uses an off-the-shelf air conditioner to produce cold air, converting a well-insulated room into a cold room at much lesser cost than that needed to buy a refrigeration unit. It keeps a well-insulated room as cold as 4°C, consistently, while at the same time using about half the electricity of a comparably sized standard compressor.</p>  <p>Coolbot™</p>
Justification	CoolBot provides inexpensive, effective cooling. Appropriate cooling reduces postharvest losses and extends shelf-life for consumption and marketing. Farmers who can store their produce longer can take advantage of better prices, as market prices can fluctuate dramatically over time.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, aggregators, traders, exporters, household consumers
Approaches used in dissemination	Training workshops, demonstrations, extension materials, exposure tours to packhouses and collection centres
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• IncUse of locally available materials to construct the coolers</li> <li>• Funding to promote the coolers</li> <li>• Formation of marketing groups that would construct the coolers communally</li> <li>• County and Central Government support</li> <li>• Well organized farmer groups and networksrease postharvest training and direct farmer outreach</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers groups to be trained in postharvest handling of the garden peas</li> <li>• Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot™ Technology</li> </ul>


<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Makueni
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Kericho, Bomet, Meru, Embu, Kirinyaga, Laikipia, Kisii, Muranga, Kakamega, Vihiga
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of knowledge on the technology and the benefits of cooling garden peas.</li> <li>• Limited awareness of the technology by farmers</li> <li>• Inadequate funds to install the Coolbot™</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the technology to farmers and traders</li> <li>• Capacity building of value chain actors on how to use the technology</li> <li>• Linkage to credit facility providers to promote commercialization, advocacy for its widespread use</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Linking entrepreneurs to credit and market enhances adoption of Coolbot™ technology</li> <li>• Farmers have often been encouraged to form groups as a strategy to enhance their bargaining power. Groups have also exploited group advantage to get training/extension services and buy agro-inputs more cheaply.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• The CoolBot™ can be solar powered, hence ideal in areas with good amount of solar radiation</li> <li>• Ability of farmers to practice collective marketing of garden peas</li> <li>• Proper linkages between industry, farmer cooperatives, local and regional markets, and bulk purchases</li> <li>• Existing and new export markets are developed and maintained</li> <li>• Policies to encourage cold chain in horticulture sector are implemented.</li> <li>• Favourable policy, encouraging better prices for properly-preserved garden pea</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	<ul style="list-style-type: none"> <li>• CoolBot (US\$ 300)</li> <li>• Air conditioner</li> <li>• Insulated room</li> <li>• Monthly electricity costs</li> </ul>
Estimated returns	<ul style="list-style-type: none"> <li>• Increased income. Farmers can store garden peas to sell in the off-season when prices are higher.</li> <li>• Improved cold storage facilities will stabilize garden peas prices, giving consumers access to nutritious fresh produce all year.</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers are better protected to erratic market prices.</li> </ul>
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge on the Coolbot™ cold storage technology</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women and youth have less access to credit to purchase the technology than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge on the Coolbot™ cold storage technology</li> <li>• Women and youth have less access to credit to purchase the technology than men</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories	Farmers in Embu, Kirinyaga, etc. have adopted the technology
Application guideline for users	CoolBot™ factsheets, brochures and manuals available from KALRO
<b>F: Status of TIMP readiness</b> (1- ready for upscaling; 2- requires validation; 3- requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC; KALRO Kanadara, KALRO Sericulture P.O. Box 220 - Thika
Lead organization and scientists	KALRO Francis Wayua, Antony Nyaga, Nasambu Okoko, Eliud Gatambia, Caesar Kambo and Sylvia Kuria
Partner organizations	KEBS, MoALF

Gaps:

- Research on innovative investment options for farmers and groups.
- Gross margins of the Coolbot™



<b>2.7.4 TIMP Name</b>	<b>Wakati™ technology</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Lack of cooling technologies for Garden Peas
What is it? (TIMP description)	<p>Wakati™ is a simple and innovative solution where altered environment in the chamber contributes to shelf life extension. Altered environment is due to high relative humidity, and oxidation of ethylene from the storage environment by oxidizing (ozone oxidation). It is a 1m by 1m canvas tent with a solar powered fan at one corner. The fan is placed in a cuplike reservoir. As it rotates, it picks up water into mist droplets, which are distributed in the tent by air currents. When a moisture concentration of 80% is achieved, the surface of the vegetable remains fresh because there is no loss of water. This low-cost solution helps produce last up to 10 times longer without any refrigeration.</p> 
Justification	Appropriate cooling reduces postharvest losses. The technology increases the length of time garden peas can be stored without refrigeration, gives farmers more time to sell. The climate control approach used by Wakati™ is affordable and clean technology.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers and sellers of fresh Garden Peas (green grocers). It is appropriate for rural farmers and agro-dealers.
Approaches used in dissemination	Training workshops, demonstrations, extension materials, exposure tours
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Use of locally available materials to construct the coolers</li> <li>• Funding to promote the coolers</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers groups to be trained in postharvest handling of the Garden Peas</li> <li>• Scientists and agricultural extension workers- to provide farmers with knowhow on Wakati™ technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Makeni
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Kericho, Bomet, Meru, Embu, Kirinyaga, Laikipia, Kisii, Muranga, Kakamega, Vihiga

Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of knowledge on the technology and the benefits of cooling Garden Peas</li> <li>• Limited awareness of the technology by farmers</li> <li>• Inadequate funds to install the Wakati™</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the technology to farmers and traders</li> <li>• Capacity building of value chain actors on how to use the technology</li> <li>• Linkage to credit facility providers to promote commercialization, advocacy for its widespread use</li> </ul>
Lessons learned in up scaling if any	Need to continue capacity building of the farmers and users on construction, repair and maintenance of the technology
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• The sand should be continuously moist. Cooling is more effective in dry and windy environment</li> <li>• Ability of farmers to practice collective marketing of garden peas</li> <li>• Proper linkages between industry, farmer cooperatives, local and regional markets, and bulk purchases</li> <li>• Existing and new export markets are developed and maintained</li> <li>• Policies to encourage cold chain in horticulture sector are implemented.</li> <li>• Favourable policy, encouraging better prices for properly-preserved garden pea</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge on the Wakati™ technology</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women and youth have less access to credit to purchase the technology than men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge on the Wakati™ technology</li> <li>• Women and youth have less access to credit to purchase the technology than men</li> <li>• VMGs have limited access to training and extension services.</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>• There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>

<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Embu and Kirinyaga have adopted the technology
Application guideline for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management Practices. KALRO / KCSAP project, February 2021.
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC; KALRO Kanadara, KALRO Sericulture P.O. Box 220 - Thika
Lead organization and scientists	KALRO Francis Wayua, Antony Nyaga, Nasambu Okoko, Eliud Gatambia, Caeser Kambo and Sylvia Kuria
Partner organizations	KEBS, MoALF

#### GAPS:

1. Research on innovative investment options for farmers and groups. Identify enterprises eager to promote the Wakati™.
2. Gross margins of the Wakati™


<b>2.7.5 TIMP Name</b>	<b>Modified Atmosphere Packaging of Garden Peas</b> (Ziploc® and Xtend® bag packaging)
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	High postharvest losses due to lack of appropriate packaging
What is it? (TIMP description)	Xtend® bags are modified atmosphere bags characterized by high moisture vapor transmission rates. This assures that excess moisture is eliminated, in the event that condensation forms within the bag. The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of garden peas for 5-7 days
Justification	The Xtend® bags under room conditions is a low-cost method that can retain the nutrient content and extend the shelf life of garden peas for 5-7 days.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	

Users of TIMP	Farmers and sellers of fresh garden peas (green grocers). It is appropriate for rural farmers and agro-dealers.
Approaches used in dissemination	Training workshops, demonstrations, extension materials
Critical/essential factors for successful promotion	Funding to promote the Ziploc® and Xtend® bag packaging
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers groups to be trained in postharvest handling of the Garden Peas</li> <li>• Scientists and agricultural extension workers- to provide farmers with knowhow on CoolBot Technology</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Embu, Makeni
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Kericho, Bomet, Meru, Embu, Kirinyaga, Laikipia, Kisii, Muranga, Kakamega, Vihiga
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of knowledge on the technology and the benefits</li> <li>• Limited awareness of the technology by farmers and traders</li> <li>• Lack of local availability of Ziploc® and Xtend® packaging bags</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Awareness creation about the technology to farmers and traders</li> <li>• Capacity building of value chain actors on how to use the technology</li> <li>• Linkage to credit facility providers to promote commercialization, advocacy for its widespread use</li> <li>• Availability of Ziploc® and Xtend® bag packaging close to farmer</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Need to continue capacity building of the farmers and users on modified atmosphere packaging of garden peas.</li> <li>• Need to avail the packaging bags close to farmers.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	To enhance adoption, work with industry, farmer cooperatives, local and regional markets, and bulk purchases to adopt the CoolBot™
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	The entire kit costs about KES 10,000/-
Estimated returns	Reduced postharvest losses, increased income, enhanced nutrition
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge on the Ziploc® and Xtend® bag packaging technology</li> <li>• Women and youth have limited access to education, training and extension services than men</li> <li>• Women and youth have less access to credit to purchase the technology than men</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs have less access to agricultural information, technology and knowledge on the Ziploc® and Xtend® bag packaging technology</li> <li>Women and youth have less access to credit to purchase the technology than men</li> <li>VMGs have limited access to training and extension services.</li> <li>Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</li> <li>There is low adoption by VMGs due lack of awareness.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Affirmative action opportunities such as the women and youth enterprise fund and youth funds exist for women and youths to access the required finances</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Embu and Kirinyaga have adopted the technology
Application guideline for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management Practices. KALRO / KCSAP project, February 2021.
<b>F: Status of TIMP readiness</b> (1- ready for upscaling; 2- requires validation; 3- requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC; KALRO Kandara, KALRO Sericulture P.O. Box 220 - Thika
Lead organization and scientists	KALRO Charity Gathambiri, Francis Wayua, Antony Nyaga, Nasambu Okoko, Eliud Gatambia, Caeser Kambo and Sylvia Kuria
Partner organizations	KEBS, MoALF

## 2.8 VALUE ADDITION

<b>2.8.1 TIMP Name</b>	<b>Solar dryers</b> <ul style="list-style-type: none"> <li><i>Cabinet solar dryer /chimney solar dryer</i></li> <li><i>Greenhouse solar dryer</i></li> <li><i>DeHytray</i></li> </ul>
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Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Short shelf life due to high perishability of garden peas
What is it? (TIMP description)	A cabinet solar dryer for garden peas 
Justification	Garden pea is high perishability but can be preserved through solar drying. This preserves the vegetable for future use, empowers smallholders and creates rural employment.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, consumers, women and youth groups
Approaches used in dissemination	Practical demonstrations, field days, exposure tours
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Existence of effective extension services to demonstrate the technology</li> <li>• Successful in areas with good solar radiation</li> <li>• Local artisans can be trained on fabrication, repair and maintenance</li> <li>• Ensuring sanitary conditions (HACCP and GMP) when handling garden peas for drying</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Existence of effective extension services to demonstrate the technology</li> <li>• NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers, availability of solar dryers</li> <li>• KIRDI and ATDC – fabrication of solar driers, capacity building of value chain actors</li> <li>• County governments –Help in the dissemination of the technology</li> <li>• Financial institutions – provide credit to farmers to enable acquisition of the drying machines</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Isiolo, Kakamega
Counties where TIMP will be up scaled	Nyandarua, Kiambu, Kericho, Bomet, Meru, Embu, Kirinyaga, Laikipia, Kisii, Muranga, Kakamega, Vihiga

Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of information, lack of skills, financing initial capital</li> <li>• Lack of funds to acquire the solar dryers</li> <li>• Challenges in repair and maintenance</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Sensitization of the community about high health and nutrition benefits of solar dried garden peas</li> <li>• Provide appropriate financial services and credit facilities to farmers</li> <li>• Capacity building of local artisans on repair and maintenance</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Extension training and regular monitoring are essential.</li> <li>• Use of CBOs and farmer groups is essential to demonstrate practicability of the technology</li> <li>• The technology works best in dry weather (high temperatures and low relative humidity)</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Use locally available materials to fabricate the driers</li> <li>• Solar dried garden peas can be used in the dry season</li> <li>• Environmentally friendly resilient and climate smart. The technology uses solar energy and does not negatively affect the environment.</li> <li>• The technology works best in dry weather (high temperatures and low relative humidity)</li> <li>• Markets for solar dried vegetables sustained and expanded</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Cabinet solar drier costs approximately KES 20,000/-:
Estimated returns	Increased income, nutrition, reduced postharvest losses
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women have less access to information, technology and knowledge.</li> <li>• Women and youth have limited access to education, training and extension services than men.</li> <li>• Women and youths may have limited access to credit to purchase the solar drier</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment Opportunities exist for youth and women to perform the operation.</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to agricultural information, technology and knowledge</li> <li>• VMGs have limited access to training and extension services</li> <li>• Due to their social status VMGs are often excluded from decision making in development and dissemination activities</li> <li>• There is low adoption by VMGs due lack of awareness</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment Opportunities exist for youth and women to perform the operation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Farmers in Muranga, Nairobi and Kilifi have adopted the technology

Application guideline for users	Ndinya, C., Omari, F., Wayua, F., Odendo, M., Muriuki, J., Wandera W., Okoko, N., Ndubi, J., Nyaga, A., Nasirembe, W. and Ndung'u, J. (2021). Inventory of Climate Smart Agriculture African Indigenous Vegetables, Technologies, Innovations and Management Practices. KALRO / KCSAP project, February 2021.
<b>F: Status of TIMP readiness</b> (1- ready for upscaling; 2- requires validation; 3- requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Centre Director, KALRO-PTC; KALRO Kanadara, KALRO Sericulture P.O. Box 220 - Thika
Lead organization and scientists	KALRO Charity Gathambiri, Francis Wayua, Antony Nyaga, Nasambu Okoko, Eliud Gatambia, Caesar Kambo and Sylvia Kuria
Partner organizations	KEBS, MoALF, ATDC, KIRDI

## 2.9 MECHANIZATION OF GARDEN PEA PRODUCTION ACTIVITIES


<b>2.9.1 TIMP Name</b>	<b>Power tiller</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Slow and tedious processes of seedbed preparation, in the commercialized Garden Pea commodity. There is also delayed operations leading to late planting, high cost manual labour and inconsistent land preparation
What is it? (TIMP description)	A Power Tiller is a two-wheeled agricultural implement fitted with rotary tillers, disk harrow, moldboard plough, trailer, water pump or chisel at alternate times for easing farm operations. It can complete 1ha per day by one operator in about two hours. This will vary depending on the climatic conditions, soil types, soil moisture content, stamina and experience of the operator. Fuel consumption is about 15 litres per ha. Though these results varies with the technical ability of the operator.
Justification	It has multiple uses and other advantages. Power Tiller helps in preparing the soil, sowing seeds, planting seeds, spraying the fertilizers, herbicides and water. In addition to it also helps in



	pumping water, harvesting, threshing and transporting crops. A power Tiller is ideal where the land size is small. Farm sizes average less than one hectares which limit turning ability of conventional tractors while manual labour is costly and slow.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Garden Pea farmers, Extension staff, researchers, Universities
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Timeliness, efficiency, cheap cost, multiple usage
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, Universities for information Machinery fabricators</li> <li>• NGO supporting farmers for dissemination</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of the machine</li> <li>• High initial cost for small-scale farmers to import or when fabricated locally.</li> </ul>
Suggestions for addressing the Challenges	<ul style="list-style-type: none"> <li>• Fabrication of affordable Garden Pea production machines</li> </ul>
Lessons learned in up scaling if any	Mechanization in agriculture increases production, other activities as a result the machine.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community.</li> <li>• Include all gender groups in research and validation.</li> <li>• Good Policy on taxation of fabrication materials, imputation of complete units for agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic cost, complete with 2 ploughs, disc and mouldboard	280,000
Estimated returns	145,000/month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Gender Unfriendly and expensive machines</li> <li>• Garden Pea machines should be designed for easy start and operation.</li> <li>• Up-scaling should target all the gender</li> <li>• Compatibility to all gender</li> </ul>


Gender related opportunities	<ul style="list-style-type: none"> <li>• Creates employment especially for youth and women</li> <li>• Reduces drudgery for women farmers as well as men</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Facilitation to access information</li> <li>• Affordability and easy to maintain machines</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Can create employment for VMG at local level</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> </ul> User manuals
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Antony N., Eliud G., Sylvia K. and Caesar K.
Partner organizations	Local Fabricators

<b>2.9.2. TIMP Name</b>	<b>Garden Pea Plough</b>
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>• Slow and tedious processes of seedbed preparation, in a commercialized Garden Pea commodity</li> <li>• Difficult to prepare a uniform fine tilth seedbed manually</li> <li>• Delayed operation lead to late planting</li> <li>• High cost of manual Labour</li> </ul>

<p>What is it? (TIMP description)</p> 	<p>A Mouldboard plough is an agricultural implement and is generally considered to be an important tillage implement. Mouldboard ploughs are available for power tiller and tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation.</p>
<p>Justification</p>	<p>Has High Efficiency and when well-adjusted, the plough automatically seeks the desired depth. It is Versatile. The various models have different features that enable high efficiency in preparation of the land. Enables weed Control, Pest Control and Improved Soil Health.</p>
<p><b>B: Assessment of dissemination and scaling up/out approaches</b></p>	
<p>Users of TIMP</p>	<p>Garden Pea Farmers and researchers</p>
<p>Approaches used in dissemination</p>	<p>Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</p>
<p>Critical/essential factors for successful promotion</p>	<p>Fabrication of affordable implements, extension services, demonstration to farmers</p>
<p>Partners/stakeholders for scaling up and their roles</p>	<p>KALRO, universities for information Machinery fabricators NGO supporting farmers for dissemination</p>
<p><b>C: Current situation and future scaling up</b></p>	
<p>Counties where already promoted if any</p>	<p>Machakos</p>
<p>Counties where TIMP will be up scaled</p>	<p>Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya</p>
<p>Challenges in dissemination</p>	<ul style="list-style-type: none"> <li>• Lack of the machines</li> <li>• Lack of capacity for small-scale farmers to purchase</li> </ul>
<p>Suggestions for addressing the challenges</p>	<ul style="list-style-type: none"> <li>• Fabrication of affordable Garden Pea production machines</li> </ul>
<p>Lessons learned in up scaling if any</p>	<ul style="list-style-type: none"> <li>• Mechanization in agriculture increases production through efficient operations</li> <li>• Timely planting</li> <li>• Efficient input utilization</li> </ul>
<p>Social, environmental, policy and market conditions necessary for development and up scaling</p>	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community.</li> <li>• Include all gender groups in research, and validation.</li> <li>• Favourable Policy on cost of agricultural mechanization</li> </ul>

Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community.</li> <li>• Include all gender groups in research, and validation.</li> <li>• Favourable Policy on cost of agricultural mechanization</li> </ul>
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**A: Description of the technology, innovation or management practice**

<b>2.9.3.TIMP Name</b>	<b>Tine Harrow</b>
Category (i.e. technology, innovation or management practice)	Technology
Problem to be addressed	Slow and tedious processes of seedbed preparation, in a commercialized Garden Pea commodity. This presents a problem of lack of uniform levelled fine tilth seedbed manually. Delayed operation lead to late planting and High cost of manual Labour
What is it? (TIMP description)	<p>It is a harrow with peg shaped teeth of diamond cross section to a rectangular frame. It is used to</p> <ul style="list-style-type: none"> <li>• break clod</li> <li>• stir soil</li> <li>• uproot weeds</li> <li>• level ground</li> <li>• break soil</li> <li>• cover seeds.</li> </ul>
	
Justification	The cost of labour, inefficiencies breaking clods, ability of stirring soil, uprooting weeds, ease of leveling ground, breaking soil and covering seeds

**B: Assessment of dissemination and scaling up/out approaches**

Users of TIMP	Garden Pea farmers and researchers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Fabrication of affordable machines, demonstrations, training
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KALRO, Universities for informationMachinery fabricators</li> <li>• NGO supporting farmers for dissemination</li> </ul>

**C: Current situation and future scaling up**


Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of the machines</li> <li>• High cost for small-scale farmer when fabricated.</li> </ul>

	<ul style="list-style-type: none"> <li>•</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Local fabrication of affordable Garden Pea production machines</li> </ul>
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community.</li> <li>• Include all gender groups in research, and validation.</li> <li>• Favourable Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Not yet
Estimated returns	Not yet
Gender issues and concerns in development ,dissemination, adoption and scaling up	<p>Gender Unfriendly and expensive machines Garden Pea machines should be designed for easy start and operation. Up-scaling should target all the gender compatibility to all gender</p>
Gender related opportunities	<p>Creates employment especially for youth Reduces drudgery for women farmers as well as men</p>
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines
VMG related opportunities	Can create employment for VMG at local level
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1- ready for upscaling; 2- requires validation; 3-requires further research)	Requires further research
<b>G: Contacts</b>	

Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katumani@kalro.org">cd.katumani@kalro.org</a> Phone: 0711369535
Lead organization and	KALRO, Egerton University
Scientists	Nasirembe W, Antony N., Eliud G., Sylvia K. and Caesar K.
Partner organizations	Local Fabricators


<b>2.9.4 TIMP Name</b>	<b>Garden Pea Planter</b>
Category (i.e. technology, innovation or management practice)	Innovations
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Slow and tedious processes of planting, in the commercialized Garden Pea commodity. High seedling density hence need for labour in thinning. Manual labour is very expensive
What is it? (TIMP description)	 <p>A seed drill is a farm implement that sow seeds at a desired seeding rate and depth, ensuring that the seeds are covered and compacted under soil. This saves them from being eaten by birds and animals, or being dried up due to exposure to sun. With seed drill machines, seeds are distributed in rows, however the distance between seeds along the row can be adjusted by the user. This allows plants to get sufficient sunlight, nutrients, and water from the soil. A Seed Drill is designed to provide the flexibility to configure the planter to suit your requirements. Features including powder coated large capacity seed and fertilizer boxes which can sow a large range of seeds and fertilizers from both boxes. The seeding/fertilizer rate can be infinitely varied simply by moving a lever. The boxes also have a clean out plate for easy clean out.</p>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	85,000.00
Estimated returns	240,000.00/month
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Gender Unfriendly and expensive machines</li> <li>• Garden Pea machines should be designed for easy start and operation.</li> <li>• Up-scaling should target all the gender</li> <li>• compatibility to all gender</li> </ul>
Gender related opportunities	Creates employment especially for youth and women Reduces drudgery for women farmers as well as men
VMG issues and concerns in development, dissemination, adoption and scaling up	Facilitation to access information Affordability and easy to maintain machines

VMG related opportunities	Can create employment for VMG at local level
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires further research
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W, Antony N., Eliud G., Sylvia K. and Caesar K.
Partner organizations	Local Fabricators, Egerton University

<b>2.9.5.TIMP Name</b>	<b>MOTORIZED WEEDER</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Slow and tedious processes of Manual hoe weeding and of GARDEN PEA. Garden pea takes a long time before it outgrows the weeds.
What is it? (TIMP description)	It is a hand held machine that simultaneously cut the soil and weeds in Garden Pea and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter raw within GARDEN PEAs as; Amaranthus, African night shade, cow pea, spider plant, etc. This machine is designed as a suitable alternative for economic soil cultivation. It is recommended for use on small fields, rough terrains. furrow ridges, greenhouses, maize fields, orchard and gardens, Each setup of this indispensable multipurpose machine comes with options for tilling, weeding, cutting depending on how the crop spacing. It is also enabled for back carriage with flexible power options.
	
Justification	To make Garden Pea weeding faster, less tedious and more effective. Attract the youth to agribusiness through operation of the machines. Hand weeding is tedious and time consuming while manual operations are timewasting and expensive.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	GARDEN PEA Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers, training, demonstration
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA) Egerton University
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Relatively High cost for individual small-scale farmer.</li> <li>• Limited awareness of the existence of machine by the farming community.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Encourage group/cooperative ownership</li> <li>• Launch and awareness campaign through demonstrations and trainings</li> </ul>

Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>• Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Garden Pea Grader 25,000 KES per unit
Estimated returns	Capacity 0.25ha/ hour, Fuel 1 litre /hr weeding charges: KES 600 per hectares Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development, dissemination, adoption and scaling up Dissemination	Garden Pea Grader designed for easy start and operation. Men have been drawn to Garden Pea weeding by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and Distribution
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Training on local use and transportation will make it more usable.</li> <li>• Grader is affordable and could help VMGs exploit</li> </ul>
VMG related opportunities	Can create employment for VMG at local level
<b>E: Case studies/profiles of success stories</b>	
Success stories	It has reduced labour for farmers in Tharaka nithi, Kitui, and Kisumu for Garden Pea contracted farmers
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1-ready for upscaling; 2- requires validation; 3-requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and Scientists	KALRO, Egerton University Nasirembe W, Antony N., Eliud G., Sylvia K. and Caesar K.
Partner organizations	Tecsols Ltd - Nakuru

<b>2.9.6 TIMP Name</b>	<b>Motorized Sprayer</b>
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Category (technology, innovation or management practice)	Technology																																																																								
<b>A: Description of the technology, innovation or management practice</b>																																																																									
Problem to be addressed	It is a slow and tedious processes of manual spraying Garden Pea has a high number of pests that invade leaf, stem.																																																																								
What is it? (TIMP description)  <table border="1"> <caption>Nozzle Guide for Band and Directed Spraying</caption> <thead> <tr> <th></th> <th>Even Flat Fan</th> <th>Non Even Flat Fan</th> <th>Yellow Cone</th> <th>Full Cone</th> <th>Disc and Core Cone</th> </tr> </thead> <tbody> <tr> <td><b>Herbicides</b></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Pre-emerge</td> <td>Very Good</td> <td>Good</td> <td></td> <td>Good</td> <td></td> </tr> <tr> <td>Post-emerge Contact</td> <td>Good</td> <td>Very Good</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Post-emerge Systemic</td> <td>Very Good</td> <td>Good</td> <td>Very Good</td> <td></td> <td></td> </tr> <tr> <td><b>Fungicides</b></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Contact</td> <td>Good</td> <td></td> <td>Good</td> <td></td> <td>Very Good</td> </tr> <tr> <td>Systemic</td> <td>Very Good</td> <td></td> <td></td> <td></td> <td>Good</td> </tr> <tr> <td><b>Insecticides</b></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Contact</td> <td></td> <td>Very Good</td> <td>Very Good</td> <td></td> <td>Very Good</td> </tr> <tr> <td>Systemic</td> <td>Very Good</td> <td></td> <td></td> <td></td> <td>Good</td> </tr> <tr> <td><b>Growth Regulators</b></td> <td>Good</td> <td></td> <td></td> <td>Very Good</td> <td></td> </tr> </tbody> </table>		Even Flat Fan	Non Even Flat Fan	Yellow Cone	Full Cone	Disc and Core Cone	<b>Herbicides</b>						Pre-emerge	Very Good	Good		Good		Post-emerge Contact	Good	Very Good				Post-emerge Systemic	Very Good	Good	Very Good			<b>Fungicides</b>						Contact	Good		Good		Very Good	Systemic	Very Good				Good	<b>Insecticides</b>						Contact		Very Good	Very Good		Very Good	Systemic	Very Good				Good	<b>Growth Regulators</b>	Good			Very Good		A motorized sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of the chemical, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides and fertilizers on agricultural crops. Sprayers are man-portable units typically backpacks with spray guns. They are used to control; weeds that can harbour insects by use of herbicides, insect pests that can cause diseases by the use of insecticides as well as pesticides. Control of fungal diseases by the use of fungicides. Application of micronutrients on the plants.
	Even Flat Fan	Non Even Flat Fan	Yellow Cone	Full Cone	Disc and Core Cone																																																																				
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<b>Growth Regulators</b>	Good			Very Good																																																																					
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before Garden Pea forms a canopy, broad leafed weeds compete with Garden Pea seedling for nutrients and light greatly reducing their yield. Manual sprayers are labour intensive while spraying labour is too expensive. It has lower pressure reducing its efficiency hence a motorized knapsack comes in handy. A modern motorized knapsack power that pumps four times faster and covers a wide area in a short time than the manual sprayer. With the motorized sprayer, farmers can spray up to 2ha of land in one day as compared to the manual one which covers only one in a day.																																																																								
<b>B: Assessment of dissemination and scaling up/out approaches</b>																																																																									
Users of TIMP	Garden Pea Farmers and agribusiness entrepreneurs																																																																								
Approaches used in dissemination	<ul style="list-style-type: none"> <li>Farmer field and business Schools (FFBS)</li> <li>Agricultural Innovation Platforms (AIP)</li> <li>Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions</li> </ul>																																																																								
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>Applied and adaptive research to test, validate and release improved cabbage varieties</li> </ul>																																																																								

	<ul style="list-style-type: none"> <li>• A platform for interaction of Garden Pea value chain stakeholders</li> <li>• Use by Farmers</li> </ul>
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA)
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of Garden Pea innovation platforms to facilitate interaction of farmers with relevant stakeholders</li> <li>• Relatively high cost for individual small-scale farmer.</li> <li>• Limited awareness of the existence of machine among some farmers.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Establish Garden Pea innovation platforms</li> <li>• Encourage group/cooperative ownership</li> <li>• Launch and awareness campaign through demonstrations and trainings</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform</li> <li>• Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms</li> <li>• Products from local/indigenous crops attract huge market, yet very little is being done to promote growth</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>• Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development dissemination, adoption and scaling up dissemination	Motorized sprayer designed for easy start and operation. Men have been drawn to spraying by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and distribution
Gender related opportunities	<ul style="list-style-type: none"> <li>• Creates employment especially for youth</li> <li>• Reduces drudgery for women farmers as well as men</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Facilitation to access information</li> <li>• Affordability and easy to maintain machines</li> </ul>

VMG related opportunities	
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, Garden Pea and rice
Application guidelines for users	<ul style="list-style-type: none"> <li>User manuals and leaflets</li> </ul>
<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>Ready for upscaling;,</li> </ul>
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI – Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators

<b>2.9.7 TIMP Name</b>	<b>GRADER</b>
Category (i.e. technology, innovation or management practice)	Technology
<b>A: Description of the technology, innovation or management practice</b>	
Problem to be addressed	Slow and tedious processes of Manual hoe weeding and of Garden Pea. Garden pea takes a long time before it outgrows the weeds.
What is it? (TIMP description)	It is a hand held machine that simultaneously cut the soil and weeds in Garden Pea and is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to weed specified spacing inter row within Garden Peas as; Amaranthus, African night shade, cow pea, spider plant, etc.
Justification	To make Garden Pea weeding faster, less tedious and more effective. Attract the youth to agribusiness through operation of the machines. Hand weeding is tedious and time consuming while manual operations are timewasting and expensive.



<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	GARDEN PEA Farmers, researchers, entrepreneurs and University
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Use by Farmers, training, demonstration
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers(AGGRA) Egerton University
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Relatively High cost for individual small-scale farmer.</li> <li>• Limited awareness of the existence of machine by the farming community.</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Encourage group/cooperative ownership</li> <li>• Launch and awareness campaign through demonstrations and</li> </ul>
	Trainings
Lessons learned in up scaling if any	Products from local/indigenous crops attract huge market, yet very little is being done to promote growth of local industry
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation.</li> <li>• Good Policy on cost of agricultural mechanization</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
<b>Basic costs</b>	Garden Pea Grader 25,000 KES per unit
Estimated returns	Capacity 90kg/hour, Fuel 1 litre /hr Weeding charges: KES 3litre per hour Requires 1 season to return the KES 125,000 purchase price
Gender issues and concerns in development, dissemination, adoption and scaling up dissemination	Garden Pea Grader designed for easy start and operation. Men have been drawn to Garden Pea weeding by the machine. This task was predominantly for women before the introduction of the machine.
Gender related opportunities	Creates employment at production, transportation, processing and Distribution

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Training on local use and transportation will make it more usable.</li> <li>• GRADER is affordable and could help VMGs exploit</li> </ul>
VMG related opportunities	Can create employment for VMG at local level
<b>E: Case studies/profiles of success stories</b>	
Success stories	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for Garden Pea contracted farmers
Application guidelines for users	<ul style="list-style-type: none"> <li>• Demonstrations and training</li> <li>• User manuals</li> </ul>
<b>F: Status of TIMP readiness</b> (1- ready for upscaling 2- requires validation; 3-requires further research)	Ready for up-scaling
<b>G: Contacts</b>	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: <a href="mailto:cd.katamani@kalro.org">cd.katamani@kalro.org</a> Phone: 0711369535
Lead organization and Scientists	KALRO, Egerton University Nasirembe W, Antony N., Eliud G., Sylvia K. and Caesar K.
Partner organizations	Tecsols Ltd – Nakuru

## 2.10 GARDEN PEA FARMING BUSINESS AND MARKETING

<b>2.10.1. TIMP Name</b>	<b>Transformative Model of garden pea production</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 garden pea productivity due to non-shifting production from subsistence oriented to commercial orientation. This leads to poor farmer-market linkages of Garden pea leading to poor market accessibility and linkages.
What is it? (TIMP description)	Transformative model of garden production involves three levels of shifting. As farmers gain production skills and improved access to markets, the production of garden pea shifts from subsistence, to semi-commercial to fully commercial. An approach to transform smallholder farmers from the use of low improved inputs to high and therefore build market linkages. At the fully commercial level, inputs are accessed from the markets and outputs solely for the markets.
Justification	Market failures or missing markets have led to disorganization in garden pea market-oriented production. Due to the disorganization in market-oriented production of Garden pea, smallholder farmers

	fail to access markets or have limited market linkages. Therefore, the transformative model drives farmers and links them to markets.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of traders and other upstream actors</li> <li>• Acceptance of smallholder farmers to form production organizations</li> <li>• Investments in the production of quality tradable volumes</li> <li>• Acceptance of the garden pea improved varieties by consumers</li> <li>• Adaptability of the garden pea varieties</li> <li>• Prices of garden pea</li> <li>• Availability of storage infrastructure and transport</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Formation of production groups, investments in Garden pea production</li> <li>• County extension staff - Organization of farmers and technical service delivery</li> <li>• NGOs – Organization of farmers and service delivery</li> <li>• Private sector (local traders and exporters) – Support in input services and providing markets for the Garden pea production</li> <li>• Research institutions – Availing improved seeds, backstopping</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Areas in Western Kenya ( Kakamega, Bungoma, Kisii, Uasin Gishu), parts of central Kenya (Embu, Nyeri, Kirinyaga, Meru)
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the garden pea varieties</li> <li>• Group dynamics</li> <li>• Amounts of seeds of the varieties</li> <li>• Weak or non-existent stakeholder innovation platforms</li> <li>• Consumer acceptance on the new varieties</li> <li>• Prices of the garden pea varieties</li> <li>• Levels of production constraints</li> <li>• Level of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production clusters</li> </ul>

	<ul style="list-style-type: none"> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the garden pea varieties – Use of promotion channels for instance media and field days</li> <li>• Group dynamics – Capacity building on the group dynamics and management</li> <li>• Weak or non-existent stakeholder innovation platforms – Formation of innovation platforms. Capacity building stakeholders on elements of innovation platforms</li> <li>• Consumer acceptance on the new varieties – Promotion of new garden pea varieties through field days.</li> <li>• Prices of the garden pea varieties – Value addition, producer organization, managing costs in production, capacity building on farming as a business</li> <li>• Levels of production constraints – Enhancing adoption of Garden pea TIMPs</li> <li>• Level of policy support – Use of National agricultural strategies. Lobbying for the County support in policy options</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• High market competition with other garden pea varieties</li> <li>• Agro-ecological zone considerations</li> <li>• The transformative process is constraints by many factors</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – acceptability by the farmers, group dynamics, cultures</li> <li>• Environmental conditions – Enhancing natural resource management</li> <li>• Policy conditions – Policy support in extension, inputs, prices, production organizations (cooperatives), infrastructure, investment environment</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women are widely discriminated in rural producer organizations that are linked to markets.</li> <li>• Women have limited access to markets than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Men and youth stand to benefit with higher profit margins through collective bargaining during marketing.</li> </ul>

VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs are widely discriminated in rural producer organizations that are linked to markets.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• VMGs stand to benefit with higher profit margins through collective bargaining and marketing.</li> <li>• Opportunities exist for unemployed youth in production and marketing through ICT.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### Further research

- Efficiency evaluation of the farmer-market linking models
- Equity distribution among the producers
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

<b>2.10.2. TIMP Name</b>	<b>Profitability analysis</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 garden pea productivity due to low income which contributes to inaccessibility of improved production inputs. The problem of failure of profitability analysis is common among the smallholder farmers of garden pea. This leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise in terms of low productivity and income.

What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the garden pea agro-enterprise. Profit analysis detects whether the business is operating at a loss or gain.
Justification	Without profitability analysis, farmers are unable to review the management success and sustainability of the garden pea farming business. It indicates areas of adjustment.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Production programme</li> <li>• Availability of data on quantities of inputs requirements, costs, outputs and value</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Defining production programme</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the garden pea production and marketing</li> </ul>
	<ul style="list-style-type: none"> <li>• Defining production programmes of Garden pea</li> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production clusters</li> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the garden pea production – Developing information hub</li> <li>• Defining production programmes of Garden pea – SWOT analysis</li> <li>• Level of policy support – support in extension services</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts with subsistence-oriented production</li> <li>• Environmental conditions – Opportunities degrading natural resource management</li> <li>• Policy conditions – Policy support in opportunities selected</li> </ul>

<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>High illiteracy levels of women leading to lack of record keeping and poor record keeping.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for youths to venture in this management practice since majority are literate and can be able to keep good farm record</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Some of the VMGs are illiterate hence cannot keep good records.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for youths to venture in this management practice since majority are literate and can be able to keep good farm record.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Budget templates are ready for up-scaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

GAPS

Further research

- Software for running the budgets
- Profitable opportunities
- Performance of budgets

<b>2.10.3. TIMP Name</b>	<b>Market Research</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 garden pea productivity due to farmers' lack of market information on outlets and prices. This leads to information asymmetric among farmers.
What is it? (TIMP description)	Market research is a practice by farmers to gather market information to help them in business planning and organizing the production.
Justification	Poor farmers in many remote areas do not understand how the market works or why prices fluctuate;. They have little or no information on market conditions, prices and quality of goods. They are not organized collectively; and have no experience of market negotiation. They have little appreciation of their capacity to influence the terms and conditions upon which they enter the market. .Difficultmarket access restricts opportunities for income generation. Farmer market research provides relevant data to help solve marketing challenges that farmer's most likely face in their farm businesses.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, Extension, NGOs, Researchers.
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Organization of farmers</li> <li>• Formation of market research group or market opportunity group</li> <li>• Availability of facilitators</li> <li>• Availability of many traders</li> <li>• Production volume and quality</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Formation of market opportunity group</li> <li>• County extension staff - Facilitators</li> <li>• NGOs – Facilitators</li> <li>• Private sector (local traders and exporters) – Buyers</li> <li>• Research institutions – Facilitators</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Formation of market opportunity group</li> <li>• Availability of information</li> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of producer organization</li> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Formation of market opportunity group</li> </ul>

	<ul style="list-style-type: none"> <li>• Availability of information</li> <li>• Levels of policy support</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts with subsistence-oriented production</li> <li>• Environmental conditions – Over-use of cultivated land due to over-production of Garden pea</li> <li>• Policy conditions – Policy support in market opportunity groups</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of women and youth in market research.</li> <li>• Women have less access to market information than men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for educated youths in market research</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs also have limited participation in market research.</li> <li>• VMGs have less access to market information</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Employment opportunity exist for educated youths in market research.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO
	Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### Further research

- Performance of market opportunity groups
- Sustainability of the market opportunity groups
- Equity distribution in sales and income

<b>2.10.4.TIMP Name</b>	<b>Collective marketing</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 garden pea productivity due to farmers marketing individually without the targets. Smallholders acting alone typically lack the production volume and the bargaining power to command on-time delivery of agricultural inputs at reasonable prices.
What is it? (TIMP description)	Collective marketing is a characteristic of producer organization which is a group of producers formed with an objective of accessing markets and reducing market failures. It is a legal entity established to bring farmers together to benefit from marketing.
Justification	The rural poor are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power they require to interact on equal terms with other, generally larger and stronger, market intermediaries. Cultural and social distance, and discrimination, may also be factors that at least partly exclude the poor from markets. Therefore, formation of producer organizations would reduce these constraints.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of County policies</li> <li>• Willingness of farmers</li> <li>• Availability of targeted markets</li> <li>• Availability of agreements</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Members of producer organization</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Targeted markets</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up Scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers' in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the garden pea production and marketing</li> <li>• Group dynamics</li> </ul>

	<ul style="list-style-type: none"> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production organizations</li> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the garden pea production and marketing – Capacity building on sources of information.</li> <li>• Group dynamics – Capacity building</li> <li>• Level of policy support – support in extension services</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts with subsistence-oriented production</li> <li>• Environmental conditions – Degradation of natural resources due to over-production</li> <li>• Policy conditions – Policies supporting formation and functioning of producer organizations</li> <li>• Market conditions – Existing demand</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women are widely discriminated in rural producer organizations.</li> <li>• Women also have limited participation and influence in rural producer organizations.</li> <li>• Limited access to assets, resources and services, required to join groups.</li> <li>• Strict rules of entry and requirements of producers' organizations may limit women participation.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women and youths to benefit from higher profit margins through collective bargaining during marketing.</li> <li>• Opportunities exist for unemployed youth in collective marketing through ICT.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs are widely discriminated in rural producer organizations.</li> <li>• VMGs also have limited participation and influence in rural producer organizations.</li> </ul>

	<ul style="list-style-type: none"> <li>Limited access to assets, resources and services, required to join producer groups.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>VMGs stand to benefit with higher profit margins through collective bargaining and marketing.</li> <li>Opportunities exist for unemployed youths in collective marketing through ICT.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### Further research

- Performance of producer organizations
- Production efficiency in garden pea production due to the formation of producer organizations
- Equity distribution in income

<b>2.10.5 TIMP Name</b>	<b>Marketing innovation model</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 garden pea productivity due to low adoption of innovations in production and marketing. As farmers produce and market garden pea, they fail to follow business principles including marketing strategies in farm operations and farm activities geared toward making a profit.
What is it? (TIMP description)	The marketing innovation model is characterized by the entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic

	goods and ultimately profit. Some of the innovations include identification of the opportunities and strengths
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels. Failure to apply innovation in marketing of garden pea the market outlook will be narrow. Without entrepreneur skills, farmers will remain at subsistence farming. The characteristics of subsistence farmers are production for self-sufficiency and limited incentive for the market, limited participation in input and output markets, limited investment in inputs and technology, reliance on retained seeds or donated inputs and traditional technology, little valuation of inputs and outputs and wide product mix. The characteristics of commercial farmers are production for the market with a strong focus on generating profits, active participation in input and output markets, active investments in inputs and technology, reinvestment of profits into inputs and technology, valuation of inputs, outputs and narrow product range.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of innovations</li> <li>• Farmers' willingness to finance the innovations</li> <li>• Risk tolerance levels</li> <li>• Levels of production</li> <li>• Levels of profit</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Undertakes innovations</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Demanding goods</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the garden pea production and marketing</li> <li>• Subsistence farming</li> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> </ul>

	<ul style="list-style-type: none"> <li>• Inadequate information to stakeholders on the garden pea production – Developing information hub</li> <li>• Subsistence farming – adoption of innovations</li> <li>• Level of policy support – support in extension services</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts with subsistence-oriented production</li> <li>• Environmental conditions – supporting use of innovations</li> <li>• Policy conditions – Policy supporting innovations</li> <li>• Market conditions – Less garden pea market competition</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women lack entrepreneurial skills and capacity to engage in entrepreneurship compared with men</li> <li>• Women lack basic reading and numeracy skills so they can run their businesses compared with men</li> <li>• Women do not know how to save their money that can be used in entrepreneurship compared with men</li> <li>• Women do not usually apply for loans that can be used to manage their businesses and increase their profits due to lack of collateral compared with men</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women to venture in entrepreneurship through the women enterprise fund</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs lack basic reading and numeracy skills so they can run their businesses compared with men</li> <li>• VMGs lack the business acumen compared with men</li> <li>• VMGs lack the starting capital</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs to venture in entrepreneurship through affirmative action funds e.g. Uweso fund etc.</li> </ul>

<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### Further research

- Rates of innovation adoption
- Levels of subsistence
- Productivity of Garden pea
- Profitability

<b>2.10.6 TIMP Name</b>	<b>Contracted production model</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 garden pea productivity due to market failure to coordinate increase in garden pea production. The markets are dis-organized leading to dis-organized production among the smallholder farmers
What is it? (TIMP description)	Contract farming involves contractors who private companies are extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product contracted out to producers at an agreed price. On the other hand, producers provide labour and manage the contracted farming activity
Justification	Without contract farming smallholder farmers face poor market access for the Garden pea production. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to

	buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased Incomes, reduction in the risk of price fluctuations, credit and financial intermediation,
	timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of willing farmers</li> <li>• Availability of traders</li> <li>• Competitiveness of Garden pea varieties</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Contract party and beneficiaries</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Contract party and beneficiaries</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on contract farming</li> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production clusters</li> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the garden pea production – Developing information hub</li> <li>• Inadequate information to stakeholders on contract farming – Capacity building</li> <li>• Level of policy support – support in extension services</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts with subsistence-oriented production</li> <li>• Environmental conditions – Input support in the contract to improve natural resource management</li> <li>• Policy conditions – Policy support in opportunities selected</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women have less access to knowledge and information on contract farming than men.</li> <li>• Women have less access to land for farming than men.</li> <li>• Women have less access to credit required to purchase the required inputs for contract farming</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women to access the required credit through the women enterprise funds</li> <li>• Opportunities exist for youths to enter into contract farming through renting of land for farming for increased profit margins.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to knowledge and information on contract farming than men.</li> <li>• VMGs have less access to credit required to purchase the required inputs for contract farming</li> <li>• VMGs have less access to land for farming than men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs to access the required credit through the Uweso funds</li> <li>• Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria

Partner organizations	
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## GAPS

### Further research

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

<b>2.10.7 TIMP Name</b>	<b>Internet/mobile marketing</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 garden pea productivity due to poor market access caused by inadequate marketing channels, lack of skills and unavailability of market information
What is it? (TIMP description)	Internet and mobile marketing refer to the strategies used to market products and services online and through other digital means. These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet and mobile marketing methods are increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders and processors
Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Education levels of the farmers and investors in Garden pea production</li> <li>• Levels of experiences in Garden pea production</li> <li>• Availability of information on Garden pea production and marketing</li> <li>• Levels of competition among the Garden pea</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Sellers of Garden pea production</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Private sector (local traders and exporters) – Buyers of Garden pea</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	

Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Digital skills of farmers</li> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the garden pea production and marketing</li> <li>• Internet connectivity</li> <li>• Levels of policy support</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production organizations</li> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the garden pea production – Developing information hub</li> <li>• Internet connectivity – Information hub</li> <li>• Level of policy support – support in extension services</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts between subsistence-oriented production and commercial-oriented production</li> <li>• Environmental conditions – None</li> <li>• Policy conditions – Policy supporting information hub</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Women have less access to the required tools such as phones and computer than men.</li> <li>• Women are more illiterate and therefore cannot use the ICTs compared with men.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have phones or the computers.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have less access to the required tools such as phones and computer than men.</li> <li>• VMGs are more illiterate and therefore cannot use the ICTs compared with men.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for youth to use the ICT tools since most of them are highly literate and have access to phones or computers.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	

Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

Further research

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

<b>2.10.8 TIMP Name</b>	<b>Building a Business Plan for garden pea production</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 garden pea productivity due to farmers' unplanned and traditional production which lacks production targets, losses and market orientation.
What is it? (TIMP description)	A business plan is a document which guides the business operations in a farm. The document contains details such as introduction, business organization, products marketing strategy, risks, business operation plan, marketing costs, Income streams, profit and loss analysis and financial requirements. The business plan provides a roadmap for the small farm business, an overall vision and mission to drive the business.
Justification	Farming garden pea without a business plan is likely to fail because it lacks analysis of the production information, market information, financial support and business services. Building garden pea business plan will assist farmers to organize themselves both at the farm and market levels.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, financial support services

Approaches to be used in dissemination	Trainings, factsheets, manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Education levels of farmers</li> <li>• Small-scale farming of Garden pea</li> <li>• Traditional farming of Garden pea</li> <li>• Availability of information on Garden pea production and marketing</li> <li>• Availability of farm business plan</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Developing farm business plans</li> <li>• County extension staff - Capacity building</li> <li>• NGOs – Capacity building</li> <li>• Research institutions – Capacity building</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up Scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the garden pea production and marketing</li> <li>• Levels of education of farmers</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of production organizations</li> <li>• Small-scale farming – allocation of more land to garden pea production and aggregation of production to assume large scale-farming</li> <li>• Inadequate information to stakeholders on the garden pea production – Developing information hub</li> <li>• Levels of education of farmers – Trainings</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Conflicts between with subsistence- oriented production and commercial-oriented production</li> <li>• Environmental conditions – Business plans to include Natural Resource Management</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• High illiteracy levels of women leading to lack of record keeping and poor record keeping.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for the learned youths to come up with good business plans for themselves and other farmers at a cost</li> </ul>

VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Some of the VMGs are illiterate hence cannot keep good records.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for the learned youths to come up with good business plans for themselves and other farmers at a cost</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### Further research

- Adoption rate on the use of farm business plan
- Performance of the farm business plans

## Marketing practices

### 2.11 AGRICULTURAL POLICY OPTIONS

<b>2.11.1 TIMP Name</b>	<b>National Agricultural Policy Strategies Framework for supporting garden pea production and marketing</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 garden pea productivity due to lack of National Agricultural Policy in providing support to the smallholder farmers by centralizing the smallholder farmers' agency and voices in terms of access to inputs and outputs markets. Also inappropriate instruments and rules for achieving broad policy productivity objectives for the smallholder farmers but instead favour the large scale farmers in Kenya.

What is it? (TIMP description)	The National Agricultural Policy strategies framework provides the objectives, instruments and rules for implementing productivity programs for the garden pea
Justification	Without the National Agricultural policy strategy framework, garden pea production will remain not integrated with the National development objectives. There will be lack of instruments and the rules to achieve garden pea productivity objectives.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• Availability of agricultural policies and specific Garden pea- based policies</li> <li>• Availability of policy goals, objectives and key areas of concerns</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Demanding Garden pea policies to support production and marketing</li> <li>• County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> <li>• Private sector (local traders and exporters) – Demanding Garden pea policies to support production and marketing</li> <li>• Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>• Poorly established Garden pea value chain</li> <li>• Garden pea production are specific to agro-ecological zones and not all the Counties in Kenya grow Garden pea</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>• Small-scale farming – Policies for increasing productivity</li> <li>• Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>• Poorly established Garden pea value chain – strengthening garden pea value chain</li> </ul>

	<ul style="list-style-type: none"> <li>Garden pea production are specific to agro-ecological zones and not all the Counties in Kenya grow Garden pea – Diversification of Garden pea</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>Social conditions – Low productivity of Garden pea</li> <li>Environmental conditions – lack of a comprehensive land use</li> </ul>
	<p>Policy</p> <ul style="list-style-type: none"> <li>Policy conditions – Lacking specific Garden pea policy</li> <li>Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>Inadequate representation of youth and women in policy development forums at all levels.</li> <li>Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Inadequate representation of VMGs in policy development forums at all levels.</li> <li>Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### Further research

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

<b>2.11.2 TIMP Name</b>	<b>Policy cycle</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 garden pea productivity due to the development of agricultural policies not relevant to the problem emergency in garden pea production and marketing and also without staged follow-up
What is it? (TIMP description)	The policy cycle is normally conceptualized as sequential parts or stages. These are (1) problem emergence, (2) agenda setting, (3) consideration of policy options, (3) decision-making, (5) implementation, and (6) evaluation. The cycle is a valuable device for involving the smallholder farmers of garden pea to articulate their issues in the garden pea production and marketing and therefore initiate the centralization of their agencies and voices.
Justification	Without the use of policy cycle, the garden pea production and marketing will remain under-developed. There will be a disconnection between government policy setting and the likings of the smallholder farmers.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• Availability of agricultural policies and specific Garden pea-based policies</li> <li>• Availability of policy goals, objectives and key areas of concerns</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Demanding Garden pea policies to support production and marketing</li> <li>• County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> </ul>

	<ul style="list-style-type: none"> <li>Private sector (local traders and exporters) – Demanding Garden pea policies to support production and marketing</li> </ul>
	<ul style="list-style-type: none"> <li>Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination	<ul style="list-style-type: none"> <li>Disorganization and scattered farmers</li> <li>Small-scale farming</li> <li>Inadequate information to stakeholders on the agricultural policies whether National or County</li> <li>Poorly established Garden pea value chain</li> <li>Garden pea production are specific to agro-ecological zones and not all the Counties in Kenya grow Garden pea</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>Small-scale farming – Policies for increasing productivity</li> <li>Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders</li> <li>Poorly established Garden pea value chain – strengthening garden pea value chain</li> <li>Garden pea production are specific to agro-ecological zones and not all the Counties in Kenya grow Garden pea</li> <li>Diversification of Garden pea</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>Social conditions – Low productivity of Garden pea</li> <li>Environmental conditions – lack of a comprehensive land use policy</li> <li>Policy conditions – Lacking specific Garden pea policy</li> <li>Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>Inadequate representation of youth and women in policy development forums at all levels.</li> </ul>

	<ul style="list-style-type: none"> <li>Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>Inadequate representation of VMGs in policy development forums at all levels.</li> <li>Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

## GAPS

### *Further research*

- Validation of policies
- Equity distribution among the stakeholders
- Productivity levels among the smallholder farmers due to farmer-market linking models
- Farmer accessibility to production inputs

<b>2.11. 3 TIMP Name</b>	<b>County Integrated Development planning</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 garden pea productivity due to lack of County Government support in the access of inputs and outputs markets among the smallholder farmers causing dis-organization the subsector.

What is it? (TIMP description)	The County Integrated Development Planning (CIDP) is a five year plan developed by County governments to guide County investments. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in garden pea production, marketing and processing are considered. .
Justification	Without sensitizing the smallholder farmers of garden pea on the CIDP, the crop will remain under-developed. It is essential for the farmers to understand and implement the CIDP
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• Availability of County Integrated Development Plans</li> <li>• Levels of literacy among the smallholder farmers of garden pea.</li> <li>• Willingness of farmers to participate in the development of CIDP</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Providing data for the agricultural policy concerns</li> <li>• County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> </ul>
	<ul style="list-style-type: none"> <li>• Private sector (local traders and exporters) – Contributing to the development of County Integrated Development Plans</li> <li>• Research institutions – Sensitization of stakeholders</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	All Counties in Kenya
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inadequate information to stakeholders on the CIDPs County</li> </ul>
Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>• Small-scale farming – Policies for increasing productivity</li> <li>• Inadequate information to stakeholders on the CIDPs</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>

Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Low productivity of Garden pea</li> <li>• Environmental conditions – lack of a comprehensive land use policy</li> <li>• Policy conditions – Lacking specific Garden pea policy</li> <li>• Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in the development process of the county integrated plans</li> <li>• Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of VMGs in the development process of the county integrated plans</li> <li>• Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs to participate in the process of developing the county integrated development plans</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	All Counties in Kenya
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria
Partner organizations	

#### GAPS

##### Further research

- Adoption of policies
- Equity distribution among the stakeholders

- Productivity levels among the smallholder farmers due to CIDPs
- Farmer accessibility to production inputs

<b>2.11.4 TIMP Name</b>	<b>Policy instruments related to garden pea</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 garden pea productivity due to the existing policy instruments which do not support the smallholder farmers' issues in accessing inputs and outputs markets. Therefore, weak policy instruments have led to the market failure for both inputs and outputs
What is it? (TIMP description)	The policy instruments are the means to achieve policy objectives. The policy instruments related to the garden pea production and marketing include subsidy in the inputs and also minimum price for the garden pea outputs.
Justification	Without the appropriate and application of the policy instruments by the smallholder farmers, the garden pea productivity will remain low. The policy productivity objective could also be achieved through efficiency, distributive, or stability effect.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Farmers, traders, processing industries, Extension, NGOs, Research institutions
Approaches to be used in dissemination	Meetings, radio, TV, social media (WhatsApp, Facebook, twitter), internet, farmers' groups
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of stakeholders</li> <li>• Availability of policy instruments</li> <li>• Levels of literacy among the smallholder farmers of garden pea.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – Users of policy instruments</li> <li>• County extension staff - Sensitization of farmers</li> <li>• NGOs – Sensitization of farmers</li> <li>• Private sector (local traders and exporters) – Users of policy instruments</li> <li>• Research institutions – Sensitization of stakeholders</li> </ul>
	•
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMPs will be up scaled	<b>Nyeri County</b> – Garden pea were highly demanded by farmers in Nyeri County
Challenges in development and dissemination -	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers</li> <li>• Small-scale farming</li> <li>• Inappropriate policy instruments</li> </ul>

Suggestions for addressing the challenges	<ul style="list-style-type: none"> <li>• Disorganization and scattered farmers – Formation of producer organizations as an institution</li> <li>• Small-scale farming – Policies for increasing productivity</li> <li>• Update of the policy instruments</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> <li>• Social conditions – Literacy levels among the smallholder farmers of garden pea</li> <li>• Environmental conditions – lack of a comprehensive land use policy</li> <li>• Policy conditions – Lacking specific Garden pea policy</li> <li>• Market conditions - Poor market infrastructure</li> </ul>
<b>D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations</b>	
Basic costs	Farmers should produce each kg of garden pea grain at KES 30-35 per kg
Estimated returns	The farm gate price is Kshs 45-50 per kg. Market prices Kshs 60-100 per kg.
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> <li>• Inadequate representation of youth and women in policy development forums at all levels.</li> <li>• Inadequate representation of youth and women in the policy of validation process.</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.</li> </ul>
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Inadequate representation of VMGs in policy development forums at all levels.</li> <li>• Inadequate representation of VMGs in the policy of validation process.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
<b>F: Status of TIMP Readiness</b> (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
<b>G: Contacts</b>	
Contacts	Centre Director KALRO PTC, KALRO Kandara, KALRO Sericulture
Lead organization and scientists	KALRO – John Wambua, Antony Nyaga, Eliud Gatambia, Caesar Kambo, Sylvia Kuria

Partner organizations	
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GAPS

*Further research*

- Adoption of policy instruments
- Equity distribution among the stakeholders
- Farmer accessibility to production inputs

Improvement in garden pea output market



Kenya Climate Smart  
Agriculture Project

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