



Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Dry Bean Value Chain



Karanja David, Kamau Eliezah, Mutisya Daniel, Amata Ruth, Momanyi Violet, Wambua John, Makoani Wincaster, Muriithi Catherine, Odhiambo Harun, Kamau Geoffrey, Ndubi Jessica, Anastasia Kagunyu, Waswa Boaz, Towett Benard, Ndungu John, Wanjala Nasirembe, Mwangi Hottensiah, Kimani Stephen, Ochieng Berrick, Abel Too, Francis Wayua, Wasilwa Lusike and Kirigua Violet

DISCLAIMER

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

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Kenya Agricultural and Livestock Research Organization
KALRO Secretariat
P O Box 57811-00200
Nairobi, KENYA

Email: directorgeneral@kalro.org

Tel. No(s): +254-722206986/733333223

Compiled by: Karanja D. R., Kamau E.M., Mutisya D.L., Amata R.L., Wambua J., Makoani W.M., Muriithi C.W., Odhiambo H.O., Kamau G., Ndubi J.M., Waswa B.S., Towett B.K., Ndungu J., W. Nasirembe W.W., Mwangi H.W., Monanyi V.N., Kimani S.K., Ochieng B.O., Too A.K., Wayua F., Micheni A.N., Kirigua V. O and Wasilwa L. A

Editors: Nyabundi K.W., Ouda J.O., Mukundi K.T., Maina F. M., Maina P., Omondi S.P.W., Wanyama H.N. and Kedemi R.M. and Karanja D.

Editing and Publication Coordination: Kirigua V. O and Lung'aho C.

Design and layout: Nyaola E.

Typesetting: Mueni G.

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 Dry Bean 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 Dry Bean ToT Manual.

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

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

PREFACE

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

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

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

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

The National Project Coordination Unit is grateful to all who participated in the development and production of this TIMPs inventory for Dry Bean 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

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ABBREVIATIONS AND ACRONYMS

AEZ	Agro-ecological Zones
BNF	Biological Nitrogen Fixation
BT	Bacillus thuringiensis
CA	Conservation Agriculture
CIAT	International Centre for Tropical Agriculture
FFBS	Farmer Field and Business School
GAP	Good agricultural practices
HACCP	Hazard Analysis and Critical Control Point
ICM	Integrated Crop Management
IPM	Integrated Pest Management
ISFM	Integrated Soil and fertility Management
ITK	Indigenous Traditional Knowledge
IWM	Integrated weed management
KALRO	Kenya Agricultural and Livestock Research Organization
KEPHIS	Kenya Plant Health Inspectorate Services
MOALF&I	Ministry of Agriculture Livestock Fisheries & Irrigation
PABRA	Pan African Bean Research Alliance
PICS	Purdue Improved Crop Storage
SBD	Solar Bubble Dryer
TIMPs	Technologies, Innovations and Management Practices
VMGs	Vulnerable and Marginalized Groups

1.0 Definition of terms and summary tables of Dry Bean Technologies, Innovations and Management Practices (TIMPs)

1.1 Definition of terms

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

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

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

1.2 Summary of Inventory of TIMPs in the Dry Bean Value Chain

The inventory process identified 98 TIMPs comprising 44 technologies, 6 innovations and 48 management practices, distributed among the 6 sub-themes, as indicated in table 1.

Table 1: Summary of dry bean TIMPs

Commodity/V C	Sub-Theme	Technologies	Innovations	Management Practices
Dry Bean	Food Safety Management System.	0	0	2
Dry Bean	Improved dry bean varieties	22	0	0
Dry Bean	Seed system	0	0	1
Dry Bean	Agronomic management practices	3	0	7
Dry Bean	Soil Fertility Management	2	2	0
Dry Bean	Soil and Water Management	3	0	0
Dry Bean	Dry bean Crop health	0	0	21
Dry Bean	Postharvest management	3	0	0
Dry Bean	Dry bean Value addition	1	1	3
Dry Bean	Mechanization of drybean production activities	10	3	2
Dry Bean	Farming business and Marketing	0	0	8
Dry Bean	Agricultural Policy Options	0	0	4
Total		44	6	48

1.3 Summary of Status of TIMPs in dry bean Value Chain

The inventory process resulted in a total of 79 TIMPs that are ready for up-scaling, 16 TIMPs that require validation and 3 TIMPs that require further research in the sub-themes, as indicated in Table 3.

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

Commodity /VC	Sub-Theme	Ready for Up-scaling	Requires validation	Requires further research
Dry Bean	Good Agricultural Practices and Food Safety Management Systems	2	0	0
Dry Bean	Improved drybean varieties	22	0	0
Dry Bean	Dry bean seed systems	1	0	0

Dry Bean	Agronomic management practices	10	0	0
Dry Bean	Soil Fertility Management	1	3	0
Dry Bean	Soil and Water Management	3	0	0
Dry Bean	Dry bean Crop health	21	0	0
Dry Bean	Postharvest management	1	2	0
Dry Bean	Dry bean Value addition	4	1	0
Dry Bean	Mechanization of dry bean production activities	10	2	3
Dry Bean	Farming Business and Marketing	1	7	0
Dry Bean	Agricultural Policy Options	3	1	0
Total		79	16	3

Table 3: Inventory of dry bean TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Food safety management system	2.1.1 Good agricultural practice (GAP)	Management practice	Ready for up-scaling
	2.1.2. Hazard analysis critical control points (HACCP) plan for dry beans value chain in Kenya	Management practice	Ready for up-scaling
2.2 Dry Bean Varieties	2.2.1 KK Rosecoco 194	Technology	Ready for up-scaling
	2.2.2. Nyota	Technology	Ready for up-scaling
	2.2.3. Faida	Technology	Ready for up-scaling
	2.2.4 Katx 69	Technology	Ready for up-scaling
	2.2.5. Katram	Technology	Ready for up-scaling
	2.2.6 Rosecoco (GLP 2)	Technology	Ready for up-scaling
	2.2.7 Chelalang	Technology	Ready for up-scaling
	2.2.8 Tasha	Technology	Ready for up-scaling
	2.2.9 Ciankui	Technology	Ready for up-scaling
	2.2.10 Kat B9	Technology	Ready for up-scaling
	2.2.11 KK Red 16	Technology	Ready for up-scaling
	2.2.12 Wairimu (GLP 585)	Technology	Ready for up-scaling
	2.2.13 Angaza	Technology	Ready for up-scaling
	2.2.14 Miezi Mbili	Technology	Ready for up-scaling
	2.2.15 Kat B1	Technology	Ready for up-scaling

	2.2.16 Mwitmania (GLPX 92)	Technology	Ready for up-scaling
	2.2.17 KK15	Technology	Ready for up-scaling
	2.2.18 Mwezi Moja (GLP 1004)	Technology	Ready for up-scaling
	2.2.19 New Mwezi moja (GLP 1127a)	Technology	Ready for up-scaling
	2.2.20 Mac 64 (Kenya Mavuno)	Technology	Ready for up-scaling
	2.2.21 Mac 34 (Kenya Tamu)	Technology	Ready for up-scaling
	2.2.22 Mac 13 (Kenya Safi)	Technology	Ready for up-scaling
2.3 Dry Bean seed system	2.3.1 Dry bean seed production	Technology	Ready for up-scaling
2.4 Agronomic Management Practices	2.4.1 Integrated Weed Management	Management practice	Ready for up-scaling
	2.4.2 Land Preparation Practices	Management practice	Ready for up-scaling
	2.4.3. Optimum plant spacing	Management practice	Ready for up-scaling
	2.4.4. Legume Intercrop System	Management practice	Ready for up-scaling
	2.4.5. Mulching for weed control	Management practice	Ready for up-scaling
	2.4.6. Chemical Weed Control	Management practice	Ready for up-scaling
	2.4.7. Mechanical Weeding	Technology	Ready for up-scaling
	2.4.8. Safe Use of Agrochemicals	Technology	Ready for up-scaling
	2.4.9. Bean rhizobium inoculation Technologies	Technology	Ready for up-scaling
	2.4.10 Physiological Maturity Index and Harvesting	Management practice	Ready for up-scaling
2.5 Soil fertility management	2.5.1 Integrated soil fertility management	Technology	Requires validation
	2.5.2 Integrated manure management	Technology	Requires validation
	2.5.3 Rapid soil testing	Innovations	Requires validation
	2.5.4 Bean fertilizer Recommendations	Innovation	Ready for up-scaling
2.6 Soil and water management	2.6.1 Contour bunds	Technology	Ready for up-scaling
	2.6.2 Tied ridges	Technology	Ready for up-scaling
	2.6.3 Bench Terraces	Technology	Ready for up-scaling

2.7 Dry bean Crop Health	2.7.1 Integrated Management of Bean stem maggot	Management practice	Ready for up-scaling
	2.7.2 Integrated Management of Cut worms	Management practice	Ready for up-scaling
	2.7.3 Integrated Management of Aphids	Management practice	Ready for up-scaling
	2.7.4 Integrated Management of Blister Beetles	Management practice	Ready for up-scaling
	2.7.5 Integrated Management of African Boll worm	Management practice	Ready for up-scaling
	2.7.6 Integrated Management of Maruca Pod Borer	Management practice	Ready for up-scaling
	2.7.7 Integrated Management of Thrips	Management practice	Ready for up-scaling
	2.7.8 Integrated Management for bean Army worm	Management practice	Ready for up-scaling
	2.7.9 Integrated Management for corn earworm	Management practice	Ready for up-scaling
	2.7.10 Integrated Management of leaf miner	Management practice	Ready for up-scaling
	2.7.11 Integrated Management for Red spider mites	Management practice	Ready for up-scaling
	2.7.12 Integrated Management for stink bugs	Management practice	Ready for up-scaling
	2.7.13. Integrated Management for loppers	Management practice	Ready for up-scaling
	2.7.14 Integrated Management of root knot nematodes	Management practice	Ready for up-scaling
	2.7.15 Integrated Disease Management of Bean Rust	Management practice	Ready for up-scaling
	2.7.16 Integrated management of anthracnose disease	Management Practice	Ready for up-scaling
	2.7.17 Integrated management of powdery mildew disease	Management Practice	Ready for Up-scaling
	2.7.18 Integrated management of leaf spot diseases (Angular leaf spot/Cercospora leaf spot)	Management Practice	Ready for up-scaling

	2.7.19 Integrated management root rots and fusarium wilt diseases	Management Practice	Ready for up-scaling
	2.7.20 Integrated management of bacterial leaf blight & Halo blight diseases	Management Practice	Ready for up-scaling
	2.7.21 Integrated management of mosaic diseases of bean	Management Practice	Ready for up-scaling
2.8 Post harvest management	2.8.1 Solar Bubble Drier	Technology	Requires validation
	2.8.2 Hermetic Grain Storage Bags and Cocoons	Technology	Ready for Up-scaling
	2.8.3 Hermetic Sealed Metal Silo (Grain storage Silos)	Technology	Requires validation
2.9 Dry bean Value Addition	2.9.1 Value added Dry bean Grain	Technology	Ready for up-scaling
	2.9.2. Pre-cooked Dry Bean Grain Product	Innovation	Ready for up-scaling
	2.9.3 Pre-cooked 100% Dry bean Floor	Innovation	Ready for up-scaling
	2.9.4.Bean Noodles	Innovation	Ready for up-scaling
	2.9.5. Dry bean Recipes	Management Practice	Requires validation
2.10 Mechanization of dry bean production activities	2.10.1 Dry bean Planter	Innovation	Requires further research
	2.10.2. Power Tiller	Innovation	Requires further research
	2.10.3. Wheeled Tractor	Innovation	Requires further research
	2.10.4. Mouldboard plough	Technology	Ready for up-scaling
	2.10.5. Disc harrow	Technology	Ready for up-scaling
	2.10.6. Spring Tine Harrow	Technology	Ready for up-scaling
	2.10.7. Seed Planter	Technology	Ready for up-scaling
	2.10.8. Weeder	Technology	Ready for up-scaling
	2.10.9. Multi-crop cultivator (Walking)	Technology	Ready for up scaling
	2.10.10. Motorized Sprayer	Technology	Ready for up-scaling
	2.10.11. Bean Thresher	Technology	Ready for up-scaling
	2.10.12 Combine Harvester	Technology	Require validation
	2.10.13 Solar Dryer	Technology	Require validation
	2.10.14. Size Sorter	Technology	Ready for up-scaling
	2.10.15. Packager	Technology	Ready for up-scaling
2.11 Dry beans farming business and marketing	2.11.1. Transformative Model of production of Dry beans	Management Practice	Requires validation
	2.11.2. Building a business	Management	Requires validation

	plan	Practice	
	2.11.3. Collective marketing	Management Practice	Requires validation
	2.11.4. Contracted production model	Management Practice	Requires validation
	2.11.5 Profitability analysis	Management Practice	Ready for Up-scaling
	2.11.6. Market research for Dry beans farmers	Management Practice	Requires validation
	2.11.7. Marketing innovation model	Management Practice	Requires validation
	2.11.8. Internet/mobile marketing	Management Practice	Requires validation
Agricultural Policy options	2.12.1. National Agricultural Policy Strategy Framework	Management Practice	Ready for Up-scaling
	2.12.2. County Integrated Development planning	Management Practice	Ready for Up-scaling
	2.12.3 Policy Instruments	Management Practice	Ready for Up-scaling
	2.12.4. Policy cycle	Management Practice	Requires validation
	Total TIMPS	98	

2.0 DETAILED DRY BEAN VALUE CHAIN TIMPs

2.1 *Good Agricultural Practices and Food Safety Management System*

2.1.1. TIMPs name	Good Agricultural Practices (GAP)
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	<ul style="list-style-type: none"> • Declining Food safety • Reduced Food quality • Sustainable farming practices • Reduced environmental impact • Worker safety and health • Traceability
What is it? (TIMP description)	<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>It is a stematic process of implementing a standardized production system globally designed to reassure consumers about how food is</p>

	produced on the farm, Pre-farm gate or on-farm standards.
Justification	Good Agricultural Practice (GAP) is based on the principals of risk prevention, risk analysis, sustainable agriculture (by means of Integrated Pest Management (IPM) and Integrated Crop Management (ICM) to continuously improve farming systems. GAP is of utmost importance in protecting consumer health. It requires ensuring safety throughout the food chain. It must be compulsory and transparent and operate not only from the table but also upstream to include suppliers (e.g. fertilizers, plant protection) and all value chain players including providers of logistics and farm equipment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> FFBS, On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, and larger plot demonstrations.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Policy support from government particularly the enforcement of KS1758 fresh produce domestic scope standard and it passing the current public participation stage.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> Producer organizations (FPEAK, FPC, KFC, AGAK etc), NGO's, MOALID, Private extension providers, CoG, and other value chain players
C: Current situation and future scaling up	
Counties where already promoted, if any	<ul style="list-style-type: none"> Meru, Embu, Nyeri, Nyandarua, Muranaga, Embu, Kirinyaga, Kisii, Uasingishu, Nakuru, Kericho, Bomet,
Counties where TIMP will be up scaled	All counties in Kenya
Challenges in dissemination	<ul style="list-style-type: none"> Lack/inadequate knowledge on the benefits GAPs Lack of legislative mechanisms to support the GAP, in particular the domestic scope The perception that GAP is oppressive rather than supportive
Recommendations for addressing the challenges	<ul style="list-style-type: none"> Continuous training of farmers, extension staff and other value chain players
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> The low number of stakeholders aware of GAP
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> Supportive policy of national and county governments to promote adaption of GAP's.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> Sh 30 for every kg of bean produced
Estimated returns	<ul style="list-style-type: none"> The returns are high compared to non use of GAP and be even 60% increase (Ksh 18 extra)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women have less access to agricultural information, technology and knowledge on GAP than men. Women have limited access to education, training and extension

	services on GAP than men.
Gender related opportunities	<ul style="list-style-type: none"> • 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.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled. • VMGs have limited access to education, training and extension services on GAP than men. • VMGs have less access to agricultural information, technology and knowledge on GAP than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	<ul style="list-style-type: none"> • 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.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Small, holders in groups in the counties of Kirinyaga, Nyeri, Meru, Nakuru and other counties have been able to produce and export produce that is certified after adopting and complying with GAP's
Application guidelines for users	<ul style="list-style-type: none"> • Options for certification exists depending on weather it is a single holder certification or group compliance • Compliance is a process and hence takes time and involves a process of continuous improvement. • No need for farm sophistication to adopt • There is provision for taking corrective action for all noncompliance at time of assessment. • Requires continuous training and exposure to better systems
F: Status of TIMP readiness (1. Ready for upselling; 2. Requires validation; 3. Requires further research	Ready for up scaling
G: Contacts	
Contacts	Centre Directors: Kandara, NSRC; Katumani, Embu, kakamega
Lead organization and scientists	KALRO: Nyaga A., Ndungu J., Gatambia E., Kambo C., Kuria, S Musyoki R. Wasilwa, L., Kirigua, V., MuriukiSJM,
Partner organizations	MoALF&I, AFA, FPEAK, FPC, PCPB, AAK, KEPHIS, CIAT County governments, NGO's, Universities

2.1.2. TIMP Name	Food Safety Management System: Hazard Analysis Critical Control Points (HACCP) Plan for Dry bean Value Chain in Kenya
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	


Problems addressed	In dry bean value chain lack of food safety management has several consequences. a) Occurrence of biological hazards like the <i>Clostridium botulinum</i> that cause severe cerebral paralysis, b) risks associated to chemical contamination of the dry bean and its products, such as pesticide residues; which a permanent concern for dry bean consumers c) diseases resulting from hazard contaminated dry beans can be higher in some areas where its produced and consumed in large quantities resulting in a higher percentage of affected population.
What is it? (TIMP description)	<p>This food safety management system through Hazard Analysis and Critical Control Point (HACCP) in drydry bean value chain is;</p> <ul style="list-style-type: none"> ○ A system of food safety control based on the systematic identification ○ An assessment of various hazards and <p>A definition of means to control them. It is a preventive, rather than a reactive, tool that places the protection of the dry bean supply from microbial, chemical and physical hazards into the hands of food management systems.</p> <p>The HACCP system is designed to minimize the risk of food safety hazards by identifying the hazards, establishing controls and monitoring these controls.</p> <p>When this HACCP concept is applied to the management of likely adverse health effects a wholesome and safe dry bean supply can be maintained improving on trade and health within and without Kenya borders.</p>
Justification	<p>This Hazard Analysis and Critical Control Points (HACCP) system is a very important tool in assuring food safety is the dry bean value chain. It has been incorporated into the Codex Alimentarius as well as into the Kenya national food safety and public health legislation.</p> <p>This HACCP approach will be applied to all stages of the dry bean processes ranging from production to processing, transportation, retail in commercial establishments and/or direct utilization by the consumer.</p> <p>Access to prime markets of dry beans will depend on the producers' capacity to ensure continued supply of high quality dry beandry beans that meet the set safety standards.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Dry bean value chain actors, that is, farmers, traders, processor, food • vendors and consumers
Approaches used in dissemination	<ul style="list-style-type: none"> • The entire production process of the dry bean value chain will be evaluated and potential biological, chemical and physical hazards assessed at every step of the production process before the critical control points (CCPs) selected. • The HACCP plan generated will be used by stakeholders to address the hazards along the dry bean value chain in Kenya. • Dissemination of generated information will be done at national and county level, common interest groups discussions, field days, exhibitions, radio, TV and social media (WhatsApp, Facebook,

	twitter).
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • For successful promotion of food safety management system through HACCP, an expert team composed of HACCP specialist, food scientist, microbiologist, representative of the dry bean growers, public health specialist, and a quality control and safety specialist from the Kenya Bureau of Standards. Distribution of the printed HACCP plan to dry • bean value chain actors
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • Institutions with IPM and ICM programs • Institutions responsible for legislating in food safety, regulations and sale of pesticides • Institutions with the required analytical testing • Training institutions with extension programs to producers and other actors on the chain • Producers and exporters associations. • County extension staff • Universities (Public and Private) • NGOs
	o Private sector
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Homabay and Machakos Counties
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • All counties producing and consuming drydry beans in Kenya
Challenges in development and dissemination	<ul style="list-style-type: none"> • Inadequate funds to reach value chain actors
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Funding of dissemination platforms
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The value chain of dry beans is willing to adopt the HACCP plan if engaged
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • The policies in public health in place are supportive to the use of HACCP plan
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 30,000
Estimated returns	<ul style="list-style-type: none"> • The company is assured of marketing with good benefit with returns of upto extra Ksh 20,000 from basic costs.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on HACCP than men. • Women have limited access to education, training and extension services on HACCP than men.

Gender related opportunities	<ul style="list-style-type: none"> • 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.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Requires a lot of movement on the farm to maintain records and process verification which may be untenable by some VMGs who are elderly and disabled. • VMGs have limited access to education, training and extension services on HACCP than men. • VMGs have less access to agricultural information, technology and knowledge on HACCP than men. • High illiteracy level of the VMGs makes them unable to read the dissemination documents and other materials.
VMG related opportunities	<ul style="list-style-type: none"> • 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.
E: Case studies/profiles of success stories	
Success stories	N/A
Application guidelines for users	N/A
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling;
G: Contacts	
Contacts	Centre Director KALRO Njoro
Lead organization and scientists	Mr. John N. Ndung'u - FCRI - KALRO Njoro, Mr. David Karanja, KALRO Katumani, Dr. Francis Wayua, KALRO Kakamega, Beatrice Wanjiku, KALRO Njoro, Ann Muiruri, Texas A & M University, USA Mutembei, Cereal Growers Association, Kenya
Partner organizations	MoA, County Governments of Kenya, CIAT/PABRA Texas A & M University (USA), CGA, Manufactures association of Kenya, traders and supermarkets

2.2 Dry Bean Varieties


2.2.1 TIMP Name	KK Rosecoco 194
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	 <p>Source: Dr Reuben Otysula</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to root rot prevalence in medium and high potentials areas.
What is it? (TIMP description)	KK Rosecoco 194 is a large seeded red mottled bean variety. It is resistant to root rot and angular leaf spot diseases, matures within 75 days. It is high yielding (800Kg/acre) and can withstand medium to high rainfall.
Justification	As a high yielding variety with resistant to root rot and angular leaf spot diseases, KK Rosecoco 194 is suitable for farmers in medium and high potential areas faced with challenge of high yield losses due to disease and pest.
B: Assessment of dissemination and scaling up/out approaches.	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, processors, extension providers, consumers, researchers and seed producers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmers field days, demonstration plots, on-farm trials, Agricultural Innovation platforms, digital platforms and agricultural shows
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Linking all stakeholders within the bean value chain. • Organizing farmers to produce quality tradeable volumes
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO-Avail breeder's seed and technical backstopping • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-Extension services • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for variety • Farmers: Test/validate and produce • Financial institutions: provide financial services to all stakeholders
C: Current situation and future scaling up	

Counties where already promoted if any	Western Kenya Counties (Kakamega, Bungoma, Kisii, Uasin Gishu).
Counties where TIMPs will be upscaled	To be upscaled in parts of Central Kenya (Embu, Nyeri, Kirinyaga and Meru highlands).
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of adequate seed of the varieties for demonstrations • Inadequate information to stakeholders • Limited extension services • Weak or non-existent stakeholder innovation platforms.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Strengthen the production of breeder seeds for seed companies • Support improved extension services • Establish and strengthen stakeholder innovation platforms and identify the platform leaders. • Improve on seed access through the agro-dealer system and improved informal seed system
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the root rot tolerant beans either through the internet, TV and demonstration plots are willing to take up the technology.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre/ season is KES 88,000 (880kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.


Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual . The seeds are available.
F: Status of TIMP Readiness (1.Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Dr Reuben Otysula C/O Institute Director KALRO Kakamega Box 169-50100, Kakamega Email: Director.nrri@kalro.org
Lead organization and scientists	KALRO Kakamega Dr Reuben Otysula
Partner organizations	Bumbayi Seed Company, Elgon Seed Company, One acrefund, CIAT/PABRA

2.2.2 TIMP Name	Nyota
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	 <p>Source: David Karanja</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low production of beans due to recurrent moisture stress during cropping cycle in marginal and medium potentials areas.
What is it? (TIMP description)	Nyota is a large seeded red mottled and drought tolerant bean variety. It's early maturing (flowering in 30-35 days and maturing within 60-70 days). Nyota is a high yielding variety (880Kg/acre). Its upright and strong stem makes it suitable for intercropping. The variety has high grain iron content (up to 90ppm) and zinc (up to 39 ppm). It is a fast cooking variety and is also suitable for processing.
Justification	As a high yielding variety with tolerance to drought, Nyota is suitable for farmers in marginal and medium potential areas faced with challenges of recurrent terminal drought. The high grain iron and zinc content in Nyota is suitable for addressing the challenge of malnutrition especially among women and children under 5 years. Since Nyota is fast cooking, less fuel is required for cooking thereby contributing to lowering of greenhouse gas emissions.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, processors, extension providers, consumers, researchers and seed producers.
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmers field days, demonstration plots, on-farm trials, Agricultural Innovation platforms, digital platforms and agricultural shows
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • The variety to be promoted in the suitable agro-ecological zone • The promotion message to be well packaged to reach most of the target end users. • Linking all stakeholders within the bean value chain.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO-Avail breeder's seed and technical backstopping • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-Extension services • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology

	<p>dissemination</p> <ul style="list-style-type: none"> Processors: Create demand for variety Farmers: Test/validate and produce Financial institutions: provide financial services to all stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Makueni, Migori, Homabay, Kisumu, Siaya, Busia, Bungoma, Kakamega, Kiambu, Muranga, Nyeri, Nakuru, Elegeyo Marakwet, Narok, Uasin Gishu, Transzoia
Counties where TIMPs will be up scaled	Laikipia , Tharaka Nithi, Muranga and Nyeri
Challenges in development and dissemination	<ul style="list-style-type: none"> Inadequate available seeds for farmers Inadequate information for stakeholders Limited extension services
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Strengthen the production of breeder seeds for seed companies Improve on seed access through improved informal seed system Support improved extension services Establish and strengthen stakeholder innovation platforms and identify the platform leaders.
Lessons learned in up scaling if any	<ul style="list-style-type: none"> The stakeholders who have learned about the micro-nutrient beans either through the internet, TV and demos are willing to take up the technology and are ready to purchase the seed. Farmers are also using harvest from demo plots to produce farm saved seed.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Farmers' willingness to learn about the technology Favourable weather conditions Availability of market Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> The estimated returns per acre is KES 88,000 (880kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. Women and youth have less access to land and credit to purchase the required inputs than men.


	<ul style="list-style-type: none"> • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Improved income generation of some farmers in Mutithi village, Kiharu Sub County, Muranga County. • A factory for processing Nyota bean flour established in Machakos County • Improved income generation for Wiga farmers in Migori County, Rambwe valley farmers in Homabay County and Abosi top hill cooperative farmers in Bomet County.
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual . The seeds are available.
F. Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO, David Karanja (KALRO Katumani),
Partner organizations	CIAT, TAAT project, KALRO Seeds, Dryland Seed company, Bubayi Seed Company, Seedco seed company, Smart Logistics, AZURI Health Ltd, Primex Ltd, Cereal Growers Association (CGA)

2.2.3. TIMP Name	Faida  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	The problem of low productivity of beans at farm level due to biotic constraints. The problem of high malnutrition levels and low access to vital nutrients especially among the resource poor households.
What is it? (TIMP description)	Faida is a red mottled/ speckled variety with semi climber's characteristics. It has medium maturing duration, flowering within 45-46 days and maturing in (84-85 days). It is a high yielder (800Kg/acre) compared to landraces. It is suitable for medium to high potential areas and is tolerant to angular leaf spot disease and common bacterial blight. Faida is fast cooking bean, rich in zinc (up to 56ppm) and iron (up to 90ppm).
Justification	As a high yielding variety with tolerance to some diseases, Faida is suitable for farmers in medium to high potential areas faced with problem of field diseases. It is also rich iron and zinc and can be used to fight against malnutrition. The micronutrient beans with flour milling qualities are suitable for use in fortifying cereal flours. Since they are fast cooking, they use less fuel hence contribute to lowering greenhouse gas emissions.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, processors, extension providers, consumers, researchers and seed producers.
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmers field days, demonstration plots, on-farm trials, Agricultural Innovation platforms, digital platforms and agricultural shows
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • The variety to be promoted in the suitable agro-ecological zone • The promotion message to be well packaged to reach most of the target end users. • Linking all stakeholders within the bean value chain.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO-Avail breeder's seed and technical backstopping • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-Extension services • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection

	<ul style="list-style-type: none"> • CBOs, NGO's- Seed multiplication and technology dissemination Processors: Create demand for variety • Farmers: test/validate and produce • Financial institutions: provide financial services to all stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Migori, , Kiambu,Muranga, Nakuru, Narok, Uasin Gishu, Transzoia
Counties where TIMPs will be up scaled	Homabay, Bungoma, Kakamega Laikipia and Nyeri
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seeds unit (Kandara) certified seeds by East Africa Seed Company • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the micro-nutrient beans either through the internet, TV and demos are willing to take up the technology and are ready to purchase the seed. • Farmers are also using harvest from demo plots to produce farm saved seed.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Bean crop is normally a women crop and the interest group due to commercial nature may deprive women one of their income source. • Availability of a market that creates demand • Policies that support seed systems and flour fortification. • Promotion in it suitable agro-ecological zone
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 80,000 (800kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase


	<p>the required inputs than men.</p> <ul style="list-style-type: none"> • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	CIAT, KALRO, TAAT: (2019). High Iron and Zinc Bean Varieties in Kenya. Faيدا seed is available from East African Seed Company
F. Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	East Africa Seed Company, CIAT, TAAT project, KALRO seeds, Smart Logistics, AZURI Health ltd, Primex ltd, Financial institutions, NGOs, CBOs, EADC, CGA

2.2.4 TIMP Name	KATX69
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	 <p>Source: David Karanja</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to recurrent moisture stress during cropping cycle in marginal and medium potentials areas.
What is it? (TIMP description)	KATX69 is a large seeded red mottled bean variety with kidney shaped grain. It has determinate growth habit making it suitable for intercropping. It's an early maturing (60-65 days) variety with white flowers. It's a high yielding (800 Kg/acre) variety with resistance to important diseases such as rust, common bean mosaic virus (BCMV), angular leaf spot and charcoal rot. It's suitable for cold dry highlands and dry lowlands areas.
Justification	As a high yielding variety with tolerance to drought and disease resistance, KatX 69 is suitable for farmers in both dry cold highlands and dry lowlands with challenges of drought and diseases. The red mottled market class of this variety is already acceptable in the local Kenyan market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, bean processing industries
Approaches used in dissemination	<ul style="list-style-type: none"> • Demonstration plots, field days, exhibitions, radio, TV, social media and internet.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO-Avail breeder's seed and technical backstopping • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-Extension services • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for variety • Farmers: Test/validate and produce • Financial institutions: Provide financial services to all stakeholders

C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Altitude areas 900-1500masl. Areas in North Rift Kenya (Transzoia, Uasin Gishu), parts of South Rift (Bomet, Narok, Elegeyo Marakwet, Nakuru, Baringo), Nyanza region (Migori, Homabay, Kisumu, Siaya, Busia, Bungoma), parts of Central Kenya (Muranga, Kiambu, Nyeri, Embu, Meru), parts of lower Eastern (Machakos, Kitui, Makueni and Taita Taveta)
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Other parts of Homabay, Laikipia, Kisumu, Embu, Muranga, Bomet and Nyeri Counties
Challenges in dissemination	<ul style="list-style-type: none"> • Inadequate certified seeds • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seeds (Katumani) and certified seeds by Dryland Seed Ltd, Leldet Seed Company. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various bean value chain stakeholders. • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans either through the internet, TV and demonstration plots are willing to take up the technology and are ready to purchase high quality seed.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Bean crop is normally a women crop and the interest generated due to commercial nature may deprive women one of their income source. • Availability of a market that creates demand • Policies that support seed systems and flour fortification. • Promotion in it suitable agro-ecological zone
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 80,000 (800kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men.


	<ul style="list-style-type: none"> • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services on the bean variety than men. • There is low adoption by VMGs due to lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • Improved income by farmers producing KATX 56 in Laikipia and Makueni Counties.
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual . The seeds are available.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO, David Karanja
Partner organizations	Dryland Seed Company, Leldet Seed Company, NGOs,CBOs, County Governments, KEPHIS
2.2.5 TIMP Name	KATRAM

	 <p>Source: David Karanja</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The drier parts of Kenya are prone to frequent drought leading to low bean productivity.
What is it? (TIMP description)	KATRAM is a medium sized red mottled bean variety. It has ability to tolerate drought stress and therefore suitable for drought prone areas. It's an early maturing variety, flowering in 30-40 days and maturing in 60-70 days. The flowers are pinkish in colour while the stem has determinate growth habit and therefore suitable for intercropping. It's resistant to diseases such as rust and bean common mosaic virus. It has high yield potential of 800Kg/acre.
Justification	As a high yielding variety with tolerance to drought, KATRAM is suitable for farmers in marginal and medium potential areas faced with challenges of recurrent terminal drought. It's also suitable for cold dry highlands.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, processors, extension providers, consumers, researchers and seed producers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmers field days, demonstration plots, on-farm trials Agricultural Innovation platforms, digital platforms and agricultural shows
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • KALRO-Avail breeder's seed and technical backstopping • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-Extension services • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for variety • Farmers: Test/validate and produce

C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Parts of lower Eastern (Machakos, Kitui, Makueni and Taita Taveta)
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Parts of South Rift (Bomet, Narok, Elegeyo Marakwet, Nakuru, Baringo), and parts of Central Kenya (Muranga, Kiambu, Nyeri, Embu, Meru, Laikipia).
Challenges in dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms • Farmers complain that the variety is very susceptible to bruchids attack
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seeds (Katumani) and certified seeds by Dryland Seed Ltd, Leldet Seed Company. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders • Train farmers on postharvest management of the bean variety
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans either through the internet, TV and community are willing to take up the technology
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to learn about the technology • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 80,000 (800kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men.


	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	None
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual . The seeds are available.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO, David Karanja
Partner organizations	Dryland Seed Company, Leldet Seed Company, NGOs,CBOs, County Governments, KEPHIS

2.2.6 TIMP Name	Rosecoco (GLP 2)
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	 <p>Photo by Eliezah Kamau</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to abiotic and biotic stresses prevalence in medium and high potentials areas
What is it? (TIMP description)	GLP 2 is a large sized red mottled bean variety. It has medium maturing period of 90 days and can tolerate moderately low growing temperatures of 18-20 ⁰ C. The pods have good ground clearance which enables the variety to tolerate white mould disease prevalent in high humidity areas. The flowers are white in colour while the stem has strong erect determinate growth habit making it suitable for intercropping. It is resistant to angular leaf spot diseases and has high yield potential of 800Kg/acre.
Justification	As a high yielder (800Kg/acre), tolerant to low growing temperature and white mold disease, GLP 2 variety is a good bet for farmers in cold high potential areas with extended rainfall duration.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmers field days, demonstration plots, on-farm trials • Agricultural Innovation platforms, digital platforms and agricultural shows
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO-Avail breeder's seed and technical backstopping • National and County Ministry of Agriculture, Livestock, Fisheries & Irrigation-Extension services • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for variety • Farmers: Production of the variety
C: Current situation and future scaling up	
Counties where already promoted if any	Parts of Central Kenya (Embu, Nyeri, Kirinyaga, Meru) and Western Kenya (Kakamega, Bungoma, Kisii, Uasin Gishu),
Counties where TIMPs will be up scaled	Nyandarua and Muranga

Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seed unit (Thika), and certified seeds by Kenya seed company, East Africa Seed. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Successful variety promotion requires availability of ready and consistent market for anticipated increased production
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness to adapt the variety • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 80,000 (800kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men.


	<ul style="list-style-type: none"> • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Many farmers in Muranga, Nyeri, Embu and other parts of the Country have experienced bean yield increase through the production of GLP 2 variety.
Application guidelines for users	Grace Mbugua <i>et al.</i> , (2005). Dry bean production manual. KALRO Kandara
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	Kenya seed company, East Africa Seed Company, KALRO seeds, CGA, KEPHIS

2.2.7. TIMP Name	<p>Chelalang</p>  <p>(Source Dr Paul Kimurto –Egerton University)</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to abiotic and biotic stresses prevalence in medium and high potentials areas
What is it? (TIMP description)	Chelalang is a large red mottled bean variety that produces white flowers. It's a determinate bush bean variety that is high yielding (1000Kg/acre). It matures within 80-90 days. The grains have high iron (90ppm) and zinc (37 ppm) content. It's tolerant to moderate low temperatures (20°C).
Justification	As a high yielder (1000Kg/acre) and tolerant to low growing

	temperature, Chelalang variety is suitable for farmers in cold high potential areas. The variety is also rich in iron and zinc and can be used to fight against malnutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organizing farmers to produce quality tradable volumes • Acceptance of the bean varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, financial service providers to provide financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Narok, Nakuru and Bomet
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Nyeri, Muranga, Laikipia, Bungoma and Kisii
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and certified seeds by Egerton University. • Improve on seed access through the agro-dealer system and improved informal seed system • Develop and disseminate supportive technology information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness to adapt the variety • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)


Estimated returns	<ul style="list-style-type: none"> The estimated returns per acre is KES 100,000 (1000kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. Women and youth have less access to land and credit to purchase the required inputs than men. Women have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. VMGs have limited access to education, training and extension services t on the bean variety than men. There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual .
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The varieties are ready for upscaling
G: Contacts	

Contacts	Prof. Paul Kimurto, C/O Vice Chancellor, Egerton University Email: info@egerton.ac.ke
Lead organization and scientists	Egerton University, Prof. Paul Kimurto
Partner organizations	Egerton University seed unit, County governments

2.2.8. TIMP Name	Tasha  (Source Dr Paul Kimurto –Egerton University)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to abiotic and biotic stresses in in medium and high potentials areas.
What is it? (TIMP description)	Tasha is a large red mottled bean variety with determinate growth bush habit. It has moderate maturing duration (flowering in 35-40 days and maturing in 75-80 days). It is a high yielding variety (1000Kg/acre). It's tolerant to moderate low temperatures (20 ⁰ C). The grains have high zinc (37 ppm) content.
Justification	As a high yielder (1000Kg/acre) and tolerant to low growing temperature, Tasha variety is suitable for farmers in cold high potential areas. The variety is also rich in iron and zinc and can be used to fight against malnutrition.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the bean varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce,


	processors, supermarkets – value addition and consumer access, financial service providers to provide financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Narok, Nakuru and Bomet
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Nyeri, Muranga, Laikipia, Bungoma and Kisii
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and certified seeds by Egerton University. • Improve on seed access through the agro-dealer system and improved informal seed system • Develop and disseminate supportive technology information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers’ willingness to adapt the variety • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 100,000 (1000kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman’s crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information,

	technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. The seeds are available.
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The varieties are ready for upscaling
G: Contacts	
Contacts	Prof. Paul Kimurto, C/O Vice Chancellor, Egerton University Email: info@egerton.ac.ke
Lead organization and scientists	Egerton University, Prof. Paul Kimurto
Partner organizations	Egerton University seed unit, County governments

2..2.9 TIMP Name	Ciankui  (Source Dr Paul Kimurto –Egerton University)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to abiotic and biotic stresses prevalence in medium and high potentials areas
What is it? (TIMP description)	Ciankui is a red mottled medium sized bean variety. It has elliptic grain shape. It has determinate growth habit and therefore suitable for both monocropping and intercropping. It has moderate yield potential of upto 720Kg/acre. It's tolerant to moderate low temperatures (20°C). Tolerant to angular leaf spot and anthracnose diseases.
Justification	Tasha is a high yielding variety with resistance to angular leaf spot and anthracnose diseases and therefore is suitable for production in areas where these diseases are prevalent.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, bean consumers, traders, processing industries
Approaches to be used in dissemination	Demos, field days, exhibitions, radio, TV, social media(WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organising farmers to produce quality tradable volumes Acceptance of the bean varieties by consumers Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> County extension staff and IT providers to advise and provide basic information to farmers, NGOs to organize farmers and provide inputs. The private sector – seed companies and agro-dealers – seeds and agro inputs, Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, financial service providers to provide financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> Narok, Nakuru and Bomet
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> Nyeri, Muranga, Laikipia, Bungoma and Kisii
Challenges in development and	<ul style="list-style-type: none"> Production of adequate seed of the varieties

dissemination	<ul style="list-style-type: none"> Inadequate information to stakeholders or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Adequate production of breeder seed and certified seeds by Egerton University. Improve on seed access through the agro-dealer system and improved informal seed system Develop and disseminate supportive technology information to the various stakeholders Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Farmers' willingness to adapt the variety Favourable weather conditions Availability of market Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	The estimated returns per acre is KES 75,000 (750kg/ acre @ KES 100/Kg)
Gender issues and concerns in development, dissemination, adoption and scaling	<ul style="list-style-type: none"> Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. Women and youth have less access to land and credit to purchase the required inputs than men. Women have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. Due to their social status VMGs are often excluded from


	<p>decision making in development and dissemination activities.</p> <ul style="list-style-type: none"> • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya. The seeds are available.
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The varieties are ready for upscaling
G: Contacts	
Contacts	Prof. Paul Kimurto, C/O Vice Chancellor, Egerton University Email: info@egerton.ac.ke
Lead organization and scientists	Egerton University, Prof. Paul Kimurto
Partner organizations	Egerton University seed unit, County governments

2.2.10 TIMP Name	<p>KAT B9</p>  <p>Source: David Karanja</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The drier parts of Kenya are prone to frequent drought leading to low bean productivity.
What is it? (TIMP description)	KAT B9 is a small to medium seeded bean variety. The grain is brilliant red, with circular to elliptic shape. It's an early maturing variety that flowers in 30-40 days and matures in 60-65 days. It has uniform flowering

	period and the flowers are pink in colour. It's tolerant to both drought and heat stress. The yield potential is 640Kg/acre. It's tolerant to bean common mosaic virus and rust diseases.
Justification	As an early maturing variety (60-65 days), tolerant to drought and heat stress and moderate yield, Kat B9 is suitable for production in marginal areas with problem of frequent droughts and high temperatures,
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, processing industries
Approaches used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media(WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Promotion methods used
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • County extension staff to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • Seed companies and agro-dealers to provide seeds and agro inputs • local traders and exporters to provide markets for produce
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Altitude areas 900-1500masl. Areas in South Rift (Bomet, Narok, Elegeyo Marakwet, Nakuru, Baringo), Nyanza region Migori, Homabay, Kisumu, Siaya, Busia, Bungoma), parts of Central Kenya (Muranga, Kiambu, • Nyeri, Embu, Meru), parts of lower Eastern (Machakos, Kitui, Makeni and Taita Taveta)
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • The technology will be up-scaled in Laikipia and Nyeri targeting cold dry highlands or hot dry lowlands.
Challenges in dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seeds (Katumani) and certified seeds by Dryland Seed ltd. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans either through various promotion channels have demonstrated willingness to take up the technology
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to learn about beans • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	


Basic costs	<ul style="list-style-type: none"> The estimated cost of seeds is KES 5,200 per acre (20Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> The estimated returns per acre is KES 51,200 (640 kg/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. Women and youth have less access to land and credit to purchase the required inputs than men. Women have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. VMGs have limited access to education, training and extension services t on the bean variety than men. There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	<p>Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021) Climate smart dry bean guide. Nairobi, Kenya.</p> <p>https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual</p>
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling

G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO, David Karanja
Partner organizations	Dryland Seed Company, NGOs,CBOs, County Governments, KEPHIS

2.2.11 TIMP Name	KK Red 16
	 <p>Source Dr Reuben Otysula</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to root rot prevalence in medium and high potential areas
What is it? (TIMP description)	KK Red 16 is a small seeded brilliant red coloured bean variety. The grain shape is circular to elliptic. It's tolerant to root rot disease and can withstand medium to high rainfall. It matures within 75 days. KK Red 16 has indeterminate growth habit and therefore suitable for mono-cropping. Has high yield potential of up to 800Kg/acre.
Justification	As a higher yielder (800Kg/acre) and being tolerant to root rot diseases, KK red 16 is a good variety for medium to high potential areas with a problem of soil-borne root rot diseases. Its small red grain type already has a good local market.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Preferred traits by farmers, consumers and market niches • Promotion methods used
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County extension staff to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • Seed companies and agro dealers to provide seeds and agro


	<p>inputs</p> <ul style="list-style-type: none"> • local traders and exporters to provide markets for produce
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Central Kenya (Embu, Nyeri, Kirinyaga, Meru) and Western Kenya (Kakamega, Bungoma, Kisii, Uasin Gishu)
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Nakuru and Muranga
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and linking to KALRO seed unit (Kakamega) to Bubayi Seed Company and Elgon Seed Company for other seed classes to produce adequate seed for farmers • Improve on seed access through the agro-dealer system and improved informal seed system • Develop and disseminate supportive technology information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	The stakeholders who have learned about the root rot tolerant beans either through the internet, TV and demos are willing to take up the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness to learn about beans • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 5,200 per acre (20Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 64,000 (800 kg/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and

	<p>extension services than men.</p> <ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	<p>Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021). Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual. The seeds are available.</p>
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	<p>Dr Reuben Otysula C/O Institute Director KALRO Kakamega Box 169-50100, Kakamega Email: Director.nrri@kalro.org</p>
Lead organization and scientists	KALRO Kakamega - Dr Reuben Otysula
Partner organizations	Bumbayi Seed Company, Elgon Seed Company, One acrefund, CIAT/PABRA

2.2.12 TIMP Name	Wairimu (GLP 585)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to abiotic and biotic stresses prevalence in medium and high potentials areas
What is it? (TIMP description)	Wairimu is a small sized red coloured oval shaped bean variety. It is medium maturing variety (75-90 days). Wairimu has indeterminate growth habit and therefore suitable for mono-cropping. It has moderate yield potential of up to 640Kg/acre. It's tolerant to bean mosaic virus and anthracnose disease.
Justification	As a moderate yielder (640Kg/acre) and being tolerant to bean mosaic virus and anthracnose disease, Wairimu is a good variety for medium to high potential areas usually with a problem of anthracnose diseases.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the bean varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, NGOs to organize farmers and provide inputs. The private sector – seed companies and agro dealers – seeds and agro inputs, local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, financial service providers to provide financial services , • Farmers, bean consumers, traders, processing industries
C: Current situation and future scaling up	
Counties where already promoted if any	Central Kenya (Embu, Nyeri, Kirinyaga, Meru) and Western Kenya (Kakamega, Bungoma, Kisii, Uasin Gishu)
Counties where TIMPs will be up scaled	Nakuru and Muranga
Challenges in development and	<ul style="list-style-type: none"> • Production of adequate seed of the varieties

dissemination	<ul style="list-style-type: none"> • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and linking to KALRO seed unit (Kakamega) to Bubayi Seed Company and Elgon Seed Company for other seed classes to produce adequate seed for farmers • Improve on seed access through the agro-dealer system and improved informal seed system • Develop and disseminate supportive technology information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the root rot tolerant beans either through the internet, TV and demos are willing to take up the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Bean crop is normally a women crop and the interest generated due to commercial nature may deprive women one of their income source
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 5,200 per acre (20Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 51,200 (640 kg/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination,	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men.


adoption and scaling up	<ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Grace Mbugua <i>et al.</i> , (2005). Dry bean production manual. KALRO Kandara
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	Kenya seed company, East Africa Seed Company, KALRO seeds, CGA, KEPHIS

2.2.13 TIMP Name	Angaza (KMR 11)  Source: Eliezah Kamau
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	The problem of low productivity of beans at farm level due to abiotic and biotic constraints. There is also high malnutrition levels and low

	access to vital nutrients especially among the resource poor households.
What is it? (TIMP description)	Angaza is a medium sized beige red (speckled sugar) rectangular oval shaped bean variety. The grain has white hilum that is surrounded by brown halo. It is a medium maturing variety, flowering in 40-42 days and maturing in 75-85 days. Angaza has determinate growth habit and therefore suitable for both monocropping and intercropping. It has yield potential of up to 1000Kg/acre. The grains are high in iron (97ppm) and zinc (57ppm) content and are fast cooking. Tolerant to angular leaf spots.
Justification	As a high yielder (1000Kg/acre) and rich in iron and zinc content, Angaza is a good variety for production in both medium and high potential areas with moderate rainfall. The variety can be used to fight against malnutrition. The micronutrient beans with flour milling qualities are suitable for use in fortifying cereal flours. Since they are fast cooking, they use less fuel hence contribute to lowering greenhouse gas emissions.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, bean consumers, traders, processing industries
Approaches used in dissemination	Demos, field days, exhibitions, radio, TV, social media(WhatsApp, Facebook, twitter), internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> – Organising farmers to produce quality tradable volumes – Acceptance of the new varieties by consumers – Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	County extension staff and IT providers to advise and provide basic information to farmers, NGOs to organize farmers and provide inputs. The private sector – seed companies and agro dealers – seeds and agro inputs, local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, financial service providers to provide financial services
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, Narok, Uasin Gishu, Transzoia
Counties where TIMPs will be up scaled	Muranga, Nyeri, Meru, Kiambu
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seed unit (Kandara) and certified seeds by East Africa Seed Company. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the micro-nutrient beans either through the internet, TV and demos are willing to take up

	<p>the technology and are ready to purchase the seed.</p> <ul style="list-style-type: none"> • Farmers are also using harvest from demo plots to produce farm saved seed.
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Bean crop is normally a women crop and the interest and due to commercial nature may deprive women one of their income source. • Availability of a market that creates demand • Policies that support seed systems and flour fortification. • Promotion of the variety in its suitable agro-ecological zone
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 64,000 (800kg/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth


	enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	CIAT, KALRO, TAAT: (2019). High Iron and Zinc Bean Varieties in Kenya. Faida seed is available from East African Seed Company
F. Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	East Africa Seed Company, CIAT, TAAT project, KALRO seeds, Smart Logistics, AZURI Health ltd, Primex ltd, Financial institutions, NGOs, CBOs, EADC, CGA

2.2.14 TIMP Name	<p>Miezi Mbili</p>  <p>(Source Simlaw Seeds LTD)</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to abiotic and biotic stresses prevalence in medium and high potentials areas
What is it? (TIMP description)	Miezi Mbili is a large sized beige red (speckled sugar) kidney shaped bean variety. It is a medium maturing variety, flowering in 38-46 days and maturing in 75-85 days. Miezi mbili has determinate growth habit and therefore suitable for both mono-cropping and intercropping. It has yield potential of up to 750Kg/acre. It's tolerant to several diseases including flourly leaf spot, halo blight, angular leaf spot, anthracnose, common bacterial blight and bean common mosaic and necrotic virus.
Justification	As a moderate yielder (750Kg/acre) and with resistant to several

	diseases Miei mbili is a good bet for production in high potential areas with high rainfall and high disease prevalence.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, input distributors, seed producers, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs, Agricultural Innovation platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, financial service providers to provide financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Western Kenya (Kakamega, Bungoma, Kisii, Uasin Gishu), parts of Central Kenya (Embu, Nyeri, Kirinyaga, Meru).
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Nyeri County. Others counties are altitude areas 1500-1800masl. Areas in Western Kenya (Kakamega, Bungoma), parts of central Kenya (Nyandarua, Muranga, Kiambu, Kirinyaga, Meru) and Kisii highlands
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and linking to KALRO seed unit (Kakamega) to Bubayi Seed Company and Elgon Seed Company for other seed classes to produce adequate seed for farmers • Improve on seed access through the agro-dealer system and improved informal seed system • Develop and disseminate supportive technology information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the root rot tolerant beans either through the internet, TV and demos are willing to take up the technology
Social, environmental, policy and	<ul style="list-style-type: none"> • Bean crop is normally a women crop and the interest

market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> generated due to commercial nature may deprive women one of their income source
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> The estimated returns per acre is KES 60,000 (750Kg/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination, adoption and scaling	<ul style="list-style-type: none"> Women and youth have limited access to productive resources such as land, credit, and quality seeds than men <ul style="list-style-type: none"> Women and youth have limited access to education, training and extension services than men Women have limited access to markets as they sometimes cannot travel to far regional markets due to their domestic roles Women have less access to agricultural information, technology and knowledge Due to their social status women are often excluded from decision making in development and dissemination Since bean is mostly regarded as a women crop, dissemination strategies should target women more but also enhance awareness of the technology to men. Emerging commercialization of the bean may edge out women from marketing and making decisions on amount and when beans are consumed. Strategies to enable women have a say in production, marketing and consumption is essential. Changed consumption patterns may impact on nutrition.
Gender related opportunities	<ul style="list-style-type: none"> Youths and women can be involved in bean production, grain aggregation, value addition and marketing This will lead to women and youth empowerment through increased production and income
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to productive resources such as land, credit, and quality seeds VMGs have limited access to training and extension services VMGs have limited access to markets as they sometimes cannot travel to far regional markets due to either their sickness, disability or lack of exposure Due to their social status VMGs are often excluded from decision making in development and dissemination VMGs have limited access to seed and information on new varieties and production techniques VMGs face the barrier of accessing quality seed due to inadequate resources such as credit and other finances
VMG related opportunities	<ul style="list-style-type: none"> Improved nutrition from consumption of increased


	<p>quantities of beans</p> <ul style="list-style-type: none"> • Improved incomes from production and marketing of root rot tolerant beans • Business related enterprises from trading, ICT, financial and related along the bean value chain
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021). Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual . The seeds are available.
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	Prof Paul Kimani C/O Vice Chancellor, University of Nairobi-CAVS Po Box 29053-00625 Kangemi Email: principal-cavs@uonbi.ac.ke
Lead organization and scientists	University of Nairobi – Prof. Paul Kimani
Partner organizations	Simlaw seed company, CIAT/PABRA, University of Nairobi

2.2.15 TIMP Name	<p>KAT B1</p>  <p>Source: David Karanja</p>
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The drier parts of Kenya are prone to drought leading to low bean productivity
What is it? (TIMP description)	KAT B1 is an early maturing variety (60-65 days) with green yellow medium sized grain. The shape of the grain is circular to elliptic with white hilum surrounded by black halo. It has determinate growth habit and the flowers are pink in colour. KAT B1 is both drought and heat

	tolerant variety. The grains have short cooking time, are tasty and do not cause flatulence to consumers. The grain is suitable for industrial processing. It has moderate yield potential of 640Kg/acre. The variety has a wide market both locally and in the region.
Justification	As a moderate yielding variety (640Kg/acre) with tolerance to drought and heat stress, Kat B1 is suitable for farmers in marginal areas faced with challenges of drought and high temperatures during the growing cycle.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, bean consumers, traders, input merchants, seed producers, processing industries
Approaches used in dissemination	Demos, field days, exhibitions, radio, TV, social media(WhatsApp, Facebook, twitter), internet, small seed packs, Agricultural Innovation platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • Financial service providers to offer financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • North Rift Kenya parts of South Rift (Bomet, Narok, Elegeyo Marakwet, Nakuru, Baringo), Nyanza region Migori, Homabay, Kisumu, Siaya, Busia, Bungoma), Parts of central Kenya (Muranga, Kiambu, Nyeri, Embu, Meru), parts of lower Eastern (Machakos, Kitui, Makueni and Taita Taveta)
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Laikipia and Nyeri
Challenges in dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by KALRO seeds (Katumani) and certified seeds by Dryland Seed ltd. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans either through various promotion channels have demonstrated willingness to take up the technology
Social, environmental, policy and market conditions	<ul style="list-style-type: none"> • Farmers' willingness to learn about beans


necessary for development and up scaling	<ul style="list-style-type: none"> • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 76,800 (640kg/ acre @ KES 120/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	<p>Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021). Climate smart dry bean guide. Nairobi, Kenya.</p> <p>https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual. The seeds are available.</p>

F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO, David Karanja
Partner organizations	Dryland Seed Company, NGOs,CBOs, County Governments, KEPHIS

2.2.16 TIMP Name	Mwitmania (GLP-X 92)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The drier parts of Kenya are prone to drought and heat stress leading to low bean productivity
What is it? (TIMP description)	Mwitmania is a beige and brown coloured (pinto), medium sized, drought and heat stress tolerant bean variety. The grain shape is elliptic. It has medium maturity duration (70-85 days) and the flowers are white in colour. It has moderate yield potential of 600Kg/acre. It's adapted to both hot dry lowlands and cold dry highlands.
Justification	As a moderate yielder (600Kg/acre), with tolerance to cold and heat stress, Mwitmania is a good bet for hot lowlands and cold dry highlands which usually experience cold or heat related stress. Though the grain type of Mwitmania (pinto) is not popular in the Kenyan market, its wide adaptability makes it a useful for food security for rural households.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Farmers, bean consumers, traders, input merchants, seed producers, processing industries
Approaches used in dissemination	<ul style="list-style-type: none"> Demos, field days, exhibitions, radio, TV, social media(WhatsApp, Facebook, twitter), internet, small seed packs, Agricultural Innovation platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Organising farmers to produce quality tradable volumes Acceptance of the new varieties by consumers


	<ul style="list-style-type: none"> • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • financial service providers to offer financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Central Kenya (Muranga, Kiambu, Nyeri, Embu, Meru) and parts of lower Eastern (Machakos, Kitui, Makueni and Taita Taveta)
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Laikipia, Siaya, Narok, Homabay, Kajiado
Challenges in dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed by and linking to KALRO seeds (Kandara) and certified seeds by Simlaw Seed LTD and East African Seed Company. • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans either through the internet, TV and demonstration plots are willing to take up the technology.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Farmers' willingness to learn about beans • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 38,400 (640kg/ acre @ KES 60/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed.

	<ul style="list-style-type: none"> • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services for bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Grace Mbugua <i>et al.</i> , (2005). Dry bean production manual. KALRO Kandara
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	East Africa Seed Company, Simlaw Seed Ltd, KALRO seeds, NGOs, CBOs, CGA, KEPHIS.

2.2.17 TIMP Name	KK 15  Source Dr Reuben Otysula
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low production of beans due to root rot prevalence in medium and high potentials areas
What is it? (TIMP description)	KK 15 is a black coloured and elliptic kidney shaped bean variety with good tolerance to root rot diseases. It has moderate maturity duration (80-90 days) and the flowers are pink in colour. The stem has indeterminate growth habit and the grains are high in Zinc content. It has high yield potential of 800Kg/ha. It can withstand medium to high rainfall.
Justification	As a high yielder (800Kg/acre) and being tolerant to root rots diseases, KK 15 is a good variety for medium to high potential areas with problem of soil borne root rot diseases. The high grain zinc content in KK15 can help to alleviate the problem of malnutrition especially in the poor local households. Though the black grain colour does not have good local market, the grain can be used to provide food security for the farming communities.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, input merchants, seed producers, processing industries
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs, Agricultural Innovation platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce,


	<ul style="list-style-type: none"> Processors, supermarkets – value addition and consumer access, Financial service providers to offer financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> Western Kenya (Kakamega, Bungoma, Kisii, Uasin Gishu),
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> Embu, Nyeri, Kirinyaga, Meru, Machakos, Bomet, Uasin Gishu
Challenges in development and dissemination	<ul style="list-style-type: none"> Production of adequate seed of the varieties Inadequate information to stakeholders Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Adequate production of breeder seed and linking to KALRO seed unit (Katumani), Dryland Seed Ltd, Leldet Seed Company for other seed classes to produce adequate seed for farmers Improve on seed access through the agro-dealer system Develop and disseminate information to the various stakeholders Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling if any	<ul style="list-style-type: none"> The stakeholders who have learned about the root rot tolerant beans either through the internet, TV and demos are willing to take up the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Farmers' willingness Favourable weather conditions Availability of market Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> The estimated returns per acre is KES 48,000 (800kg/ acre @ KES 60/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. Women and youth have less access to land and credit to purchase the required inputs than men. Women have limited access to education, training and extension services than men.

	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Ministry of agriculture Livestock Fisheries and Cooperatives and CRAFT (2021). Climate smart dry bean guide. Nairobi, Kenya. https://snv.org/assets/explore/download/Dry%20Bean%20Production%20Manual . The seeds are available.
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Dr Reuben Otysula C/O Institute Director KALRO Kakamega Box 169-50100, Kakamega Email: Director.nrri@kalro.org
Lead organization and scientists	KALRO Kakamega - Dr Reuben Otysula
Partner organizations	KALRO seeds, Bumbayi Seed Company, Elgon Seed Company, One acrefund, CIAT/PABRA

2.2.18 TIMP name	Mwezi Moja (GLP 1004)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	The drier parts of Kenya are prone to drought leading to low bean productivity
What is it? (TIMP description)	Mwezi moja is drought and heat tolerant bean variety with violet coloured seed coat. It's an early maturing variety (65-75 days) and produces white coloured flowers. It has determinate growth habit and therefore suitable for intercropping system. It has moderate yield potential of 600Kg/acre.
Justification	As a moderate yielder (600Kg/acre), with good tolerance to both heat and drought stress, Mwezi moja is a suitable for marginal areas which usually experience heat and drought related stress. Though the grain type of Mwezi moja (Violet) is not popular in the Kenyan market, its good adaptability in drought prone areas makes it a useful in provision of food security for rural households.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, bean consumers, traders, input merchants, seed producers, processing industries
Approaches used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet, small seed packs, Agricultural Innovation platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • financial service providers to offer financial services
C: Current situation and future scaling up	

Counties where already promoted. if any	<ul style="list-style-type: none"> • Western Kenya (Kakamega, Bungoma, Kisii, Uasin Gishu),
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Embu, Nyeri, Kirinyaga, Meru, Machakos, Bomet, Uasin Gishu
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and linking to KALRO seed unit (Katumani), Dryland Seed Ltd, Leldet Seed Company for other seed classes to produce adequate seed for farmers • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans are willing to take up the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 36,000 (600kg/ acre @ KES 60/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing.


	<ul style="list-style-type: none"> Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. VMGs have limited access to education, training and extension services for bean variety than men. There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Grace Mbugua <i>et al.</i> , (2005). Dry bean production manual. KALRO Kandara
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	East Africa Seed Company, Simlaw Seed Ltd, KALRO seeds, NGOs, CBOs, CGA, KEPHIS.

2.2.19 TIMP name	New Mwezi Moja (GLP 1127)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem to be addressed	The drier parts of Kenya are prone to drought leading to low bean productivity.
What is it? (TIMP description)	New Mwezi moja is a drought and heat tolerant bean variety with greyish brown coloured seed coat. It's a moderate maturing variety (75-90 days) and produces white coloured flowers. It has determinate growth habit and therefore suitable for intercropping system. It has moderate yield potential of 600Kg/acre. It is tolerant to common bean mosaic virus, halo blight and anthracnose diseases.
Justification	As a moderate yielder (600Kg/acre), with good tolerance to drought and disease stress, new Mwezi moja is suitable for marginal and medium potential areas. Though the grain type of Mwezi moja (grey) is not popular in the Kenyan market, its good adaptability in drought prone areas makes it a useful in provision of food security for rural households.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, bean consumers, traders, input merchants, seed producers, processing industries
Approaches used in dissemination	Demos, field days, exhibitions, radio, TV, social media(WhatsApp, Facebook, twitter), internet, small seed packs, Agricultural Innovation platforms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organising farmers to produce quality tradable volumes • Acceptance of the new varieties by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • financial service providers to offer financial services
C: Current situation and future scaling up	
Counties where already promoted. if any	<ul style="list-style-type: none"> • Machakos, Makueni, Kitui, Muranga
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Laikipia, Embu, Taita Taveta, Kajiado, Homabay
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder seed and linking to KALRO seed unit (Katamani), Dryland Seed Ltd, Leldet Seed Company for other seed classes to produce adequate seed for farmers • Improve on seed access through the agro-dealer system • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders

Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • The stakeholders who have learned about the drought tolerant beans are willing to take up the technology
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Farmers' willingness • Favourable weather conditions • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 6,240 per acre (24Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 36,000 (600kg/ acre @ KES 60/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	


Success stories	
Application guidelines for users	Grace Mbugua <i>et al.</i> , (2005). Dry bean production manual. KALRO Kandara
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. The variety is ready for upscaling
G: Contacts	
Contacts	Eliezah Kamau C/O Institute Director KALRO-Kandara Box 220-01000, Thika Email: director.hri@kalro.org
Lead organization and scientists	KALRO, Eliezah Kamau
Partner organizations	East Africa Seed Company, Simlaw Seed Ltd, KALRO seeds, NGOs, CBOs, CGA, KEPHIS.

2.2.20 TIMP Name	Mac 64 (Kenya Mavuno)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low bean production due to small land size especially in high potential areas with high population density.
What is it? (TIMP description)	Mac 64 grain is red molted large seeded climbing bean variety. The grain is rectangular shaped. It's a late maturing variety (120 days) that produces white flowers. It's a high yielder with potential of upto 1500Kg/acre. It's resistant to anthracnose and common bacterial blight diseases. The variety requires staking support to climb on.
Justification	Being a high yielding (1500Kg/acre) variety with resistance to diseases, Mac 64 is a good variety for medium to high potential areas with small land sizes. The variety is able to resist the common diseases prevalent in high rainfall areas. Climbing beans produce high yields within a small unit area.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Farmers in high population density areas, bean consumers, traders, processing industries
Approaches used in	<ul style="list-style-type: none"> Demos, field days, exhibitions, radio, TV, social media, internet,

dissemination	small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Promotion should be done in areas with readily available support sticks. • Organising farmers to produce quality tradable volumes • Acceptance by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • financial service providers to offer financial services
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Kakamega and Kirinyaga
Counties where TIMPs will be upscaled	Nyeri, Muranga, Kakamega, Kisii
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Staking is a challenge to a majority of farmers • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder and certified by KALRO Seeds (Embu), University of Nairobi, Simlaw Seeds and Faida Seed Company • Improve on seed access through the agro-dealer system • Encourage farmers to venture into staking production to sell to bean growers, and use other forms of staking • Develop and disseminate information to the various stakeholders • Explore on using reusable plastic support post rather than using wood post • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Growing climbing beans can increase farmers productivity providing source of income and enhanced nutrition
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Climbing beans normally use wooden sticks and therefore if not well managed can lead to adverse environmental effects. • Farmers' must be willing to invest in buying support sticks • Favourable weather condition such as extended rainfall • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	


Basic costs	<ul style="list-style-type: none"> The estimated cost of seeds is KES 4160 per acre (16Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> The estimated returns per acre is KES 120,000 (1500/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. Women and youth have less access to land and credit to purchase the required inputs than men. Women have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. VMGs have limited access to education, training and extension services t on the bean variety than men. There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Muthamia J; Micheni A & Karanja D. (2008).Grow climbing beans for high yields.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires Validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	Micheni A C/O

	Centre Director KALRO Embu Box 27 Embu Tel: 06810116/20873
Lead organization and scientists	KALRO Embu, Micheni A.
Partner organizations	Kenya Seed Company, NGOs, CBOs, County Governments, KEPHIS

2.2.21 TIMP Name	Mac 34 (Kenya Tamu)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low bean production due to small land size especially in high potential areas with high population density.
What is it? (TIMP description)	Mac 34 grain is red molted large seeded climbing bean variety. The grain is kidney shaped. It's a late maturing variety (120 days) that produces white flowers. It's a high yielder with potential of up to 1500Kg/acre. It's resistant to angular leaf spot and common bacterial blight diseases. The variety requires staking support to climb on.
Justification	Being a high yielding (1500Kg/acre) variety with resistance to diseases, Mac 34 is a good variety for medium to high potential areas with small land sizes. The variety is able to resist the common diseases prevalent in high rainfall areas. Climbing beans produce high yields within a small unit area.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers in high population density areas, bean consumers, traders, processing industries
Approaches used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media, internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Promotion should be done in areas with readily available support sticks. • Organising farmers to produce quality tradable volumes • Acceptance by consumers • Linking stakeholders and especially farmers to markets

Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • Financial service providers to offer financial services
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Meru, Embu, Kakamega and Kirinyaga
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> • Nyeri, Muranga, Kakamega, Kisii
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Staking is a challenge to a majority of farmers • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder and certified by KALRO Seeds (Embu), University of Nairobi, Simlaw Seeds and Faida Seed Company • Improve on seed access through the agro-dealer system • Encourage farmers to venture into staking production to sell to bean growers, and use other forms of staking • Develop and disseminate information to the various stakeholders • Explore on using reusable plastic support post rather than using wood post • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	Growing climbing beans can increase farmers productivity providing source of income and enhanced nutrition
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Climbing beans normally use wooden sticks and therefore if not well managed can lead to adverse environmental effects. • Farmers' must be willing to invest in buying support sticks • Favourable weather condition such as extended rainfall • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 4160 per acre (16Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 120,000 (1500/ acre @ KES 80/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted.

	<ul style="list-style-type: none"> • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Muthamia J; Micheni A & Karanja D. (2008).Grow climbing beans for high yields.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	Micheni A C/O Centre Director KALRO Embu Box 27 Embu Tel: 06810116/20873
Lead organization and scientists	KALRO Embu, Micheni A.
Partner organizations	Kenya Seed Company, NGOs, CBOs, County Governments,

2.2.22 TIMP Name	Mac 13 (Kenya Safi)  Source: David Karanja
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low bean production due to small land size especially in high potential areas with high population density.
What is it? (TIMP description)	Mac 13 is large speckled sugar grain type climbing bean variety. It's a medium maturing variety (90 days) that produces pink flowers. It's a high yielder with potential of upto 1500Kg/acre. It's resistant to anthracnose diseases. The variety requires staking support to climb on.
Justification	Being a high yielding (1500Kg/acre) variety with resistance to diseases, Mac 13 is a good variety for medium to high potential areas with small land sizes. The variety is able to resist a common disease prevalent in high rainfall areas. Climbing beans produce high yields within a small unit area.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers in high population density areas, bean consumers, traders, processing industries
Approaches used in dissemination	<ul style="list-style-type: none"> • Demos, field days, exhibitions, radio, TV, social media, internet, small seed packs
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Promotion should be done in areas with readily available support sticks. • Organising farmers to produce quality tradable volumes • Acceptance by consumers • Linking stakeholders and especially farmers to markets
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • County extension staff and IT providers to advise and provide basic information to farmers, • NGOs to organize farmers and provide inputs. • The private sector – seed companies and agro-dealers – seeds and agro inputs, • Local traders and exporters provide markets for produce, processors, supermarkets – value addition and consumer access, • Financial service providers to offer financial services
C: Current situation and future scaling up	

Counties where already promoted if any	<ul style="list-style-type: none"> • Meru, Embu, Kakamega and Kirinyaga
Counties where TIMPs will be upscaled	<ul style="list-style-type: none"> • Nyeri, Muranga, Kakamega, Kisii
Challenges in development and dissemination	<ul style="list-style-type: none"> • Production of adequate seed of the varieties • Staking is a challenge to a majority of farmers • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Adequate production of breeder and certified by KALRO Seeds (Embu), University of Nairobi, Simlaw Seeds and Faida Seed Company • Improve on seed access through the agro-dealer system • Encourage farmers to venture into staking production to sell to bean growers, and use other forms of staking • Develop and disseminate information to the various stakeholders • Explore on using reusable plastic support post rather than using wood post • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Growing climbing beans can increase farmers productivity providing source of income and enhanced nutrition
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Climbing beans normally use wooden sticks and therefore if not well managed can lead to adverse environmental effects. • Farmers' must be willing to invest in buying support sticks • Favourable weather condition such as extended rainfall • Availability of market • Favourable policies to support seed/production, marketing and value addition
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The estimated cost of seeds is KES 4160 per acre (16Kg/ acre @ 260/Kg)
Estimated returns	<ul style="list-style-type: none"> • The estimated returns per acre is KES 90,000 (1500/ acre @ KES 60/Kg)
Gender issues and concerns in development, dissemination adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the bean variety activities such as weeding, threshing and winnowing. Therefore, the crop may increase their labor burden. This may lead to the technology not to be adopted. • The bean is considered a woman's crop therefore limiting men and youth participation in the value chain. • Emerging commercialization of the bean variety may edge out women from marketing and making decisions on amount and when beans are consumed. • Women and youth have less access to land and credit to purchase the required inputs than men. • Women have limited access to education, training and extension services than men.

	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge on the bean variety than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the various crop's activities such as planting, threshing and winnowing. • Affirmative action opportunities such as the women fund exists for women to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to productive resources for the bean variety cultivations such as land and credit than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to education, training and extension services t on the bean variety than men. • There is low adoption by VMGs due lack of awareness.
Gender related opportunities	<ul style="list-style-type: none"> • Increased production will lead to increased consumption and utilization of nutritious beans, hence improved health of VMGs especially the elderly and those recovering from HIV AIDs. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Muthamia J; Micheni A & Karanja D. (2008).Grow climbing beans for high yields.
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires Validation; 3. Requires further research)	1. Ready for up scaling;
G: Contacts	
Contacts	Micheni A C/O Centre Director KALRO Embu Box 27 Embu Tel: 06810116/20873
Lead organization and scientists	KALRO Embu, Micheni A.
Partner organizations	Kenya Seed Company, NGOs, CBOs, County government, KEPHIS

GAPS


Require Validation

- Validating new canning bean varieties for adaptability and production in bean producing zones
- Validating climbing bean varieties for adaptability and production in bean producing zones

Require Further Research

- Introgressing resistance of specific diseases like scab and bacterial wilt in Angaza, Nyota and Faída.
- Generating populations combining high yields, drought tolerance with multiple constraint resistance in the drought tolerant lines
- Introgressing resistance to drought in climbing beans
- Intro-gressing resistance of specific diseases like scab and wilt in the canning beans

2.3 Dry Bean seed system

2.3.1 TIMP Name		Bean seed production
Category (i.e. technology, innovation or management practice)	Technology	
A: Description of the technology, innovation or management practice		
Problem to be addressed	Lack of quality bean seed in adequate quantities of bean seed. There is also low access to seed by farmers and especially women who are the main producers.	
What is it? (TIMP description)	 <p>These sources of dry bean certified seed of improved varieties include public entities such as KALRO Seed Unit, Egerton seed Unit and Kenya Seed Company; and private seed companies such as Dry land seed company, Bumbayi Seed Company, East Africa Seed Company etc. It enable resource poor farmers to acquire certified seeds through building their capacity on selecting their own seeds with proper guidance from extension providers. The option is short-term and is only be done for three seasons after which a farmer is advised to source certified seed to avoid reduced yield due to lowered quality of the variety.</p>	
Nyota bean mixed with other varieties (Source. David Karanja)		
Justification	Availability of quality certified seed is mandatory for a dry bean farmer to get the potential yields a variety promises when grown in the correct agroecological zones under good management. Good Beans seed production system should assist and farmers to identify, and access the quality seed in adequate amounts. Building the capacity of farmers, in identifying and selecting genuine seed is a step to improved production. This enables farmers to preserve own quality seed when unable to buy certified seed.	
B: Assessment of dissemination and scaling up/out approaches		
Users of TIMP	<ul style="list-style-type: none"> • Dry bean farmers 	
Approaches used in dissemination	<ul style="list-style-type: none"> • Demonstrations, Exhibitions, Media, Workshops, 	
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Good seed systems to provide quality and adequate seeds • Affordability of certified seed • Good extension support to enhance production 	


	<ul style="list-style-type: none"> • Funding to meet costs of good agronomic practices
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO to conduct continuous research for improved varieties • KALRO Seed Unit to provide quality seeds • Seed companies to provide adequate improved seed amount to farmers • NGOs to mobilize farmer groups • Extension to provide training and advisory
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Makueni, Machakos, Narok, Embu, Meru, Homabay, Siaya, Kisumu, Busia. Elegeyo Marakwet
Counties where TIMP will be up scaled	<ul style="list-style-type: none"> • Laikipia, Nyeri, Baringo, Busia, Kericho, Wajir, Migori, Siaya, Makueni, Kitui, Machakos, Tharaka-Nithi, Embu, Meru.
Challenges in dissemination	<ul style="list-style-type: none"> • Low awareness of the various dry bean seed sources • Ignorance on the importance of quality dry bean seed • Low financial ability to regularly produce early generation dry bean seed leading to low quality of certified seed • Lack of funds to produce sufficient amount of certified dry bean seed
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination on the dry bean seed and seed sources • Support generation of basic and breeders seed (early generation dry bean seed) • Support production of enough seed through formal seed system • Policy on community dry bean seed production • Train on own dry bean seed selection and preservation
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Partnership with stakeholders in solving challenge quickly yield results • Demonstrations transfers knowledge and skills fairly fast
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Awareness of benefits of quality dry bean seed to the growing society • Create an enabling environment for dry bean seed access to farmers • Policy on community seed production should be put in place to guide in enabling farmers produce dry bean seed • Reduce marketing blocks and improve the dry bean seed system
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • 250/- per kg of seed
Estimated returns	<ul style="list-style-type: none"> • By using quality seed a farmer can have sh 20 more per kg purchase by offtakers and processors
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access to land for quality bean multiplication than men. • Women have less access to agricultural information, technology and knowledge than men. • Women and youth have limited access to education, training and extension services than men.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for women and youths to

	credit to rent land for seed multiplication.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for quality bean seed multiplication than men. • VMGs have less access to agricultural information, technology and knowledge than men. • VMGs have limited access to education, training and extension services than men. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities exist for VMGs to acquire credit to rent land for seed multiplication.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Seed production through contract farming by KSU and other seed companies has changed lives of many dry bean farmers
Application guidelines for users	Karanja D., Githunguri C., M'Ragwa L., Mulwa D. and Mwititi S. (2006). Variety, Characteristics and Production Guidelines of Traditional Food Crops. KARI Katumani Research Centre
F: Status of TIMP readiness (1-ready for up scaling; 2-requires validation; 3-requires further research)	1-ready for up scaling
G: Contacts	
Contacts	The Centre Director, KALRO-Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO David Karanja, Eliezah Kamau, Reuben Otsyula
Partner organizations	CIAT, Egerton Seed Unit, East Africa Seed Company, Kenya Seed Company, Dry land seed company, Seedco company, Bumbayi Seed Company

Research Gaps

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

2.4 Agronomic Management Practices

2.4.1 TIMP Name	Integrated Weed Management
Crop management practices	<p>Management practices</p> 
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds pose a major challenge in bean production. They compete for nutrients, soil moisture and space with the crop and also harbor insect pests and create an environment conducive for disease occurrence. Some of the major weeds in bean
What is it?(TIMP description)	<p>Integrated weed management (IWM) is using of several weed approaches such as preventive, physical control, biological control, use of biodegradable mulch, cultural, mechanical and chemical control the management of weeds .</p> <p>Physical control is the removal of weeds manually or mechanical means, such as hand weeding or mowing. Biological control is where you graze by big animals. Chemical control is where appropriate herbicides are used to control weeds. Cultural control includes the practice of crop rotation since various crops may influence the diversity and abundance of particular weed flora. Select robust growing varieties that cover the soil and suppress weeds in rotation. Mechanical weed management includes use of farm implements e.g use of a motorized knap weeder, which does the work much faster and is less tedious. Chemical weed management involves use of pre-emergence selective herbicides and or post-emergence selective herbicides. In manual weeding farmers carry out manual weeding at 2 weeks after planting and just before flowering (about 4-6 weeks).</p>
Justification	<p>The wide diversity of weeds affecting beans is not effectively managed by manual approaches commonly used by majority of farmers. Whereas this is effective, it is time consuming and labour intensive. Whereas manual weeding could be effective, it may also be ineffective carried out under wet conditions; all weeds may be apparently replanted. Therefore regrowth becomes a big problem. Weeds are so diverse and therefore one approach will be effective on some species and not others. Therefore you need more than one approach to keep weeds under control. Judicious use of pre- and post-emergence herbicides is emerging as a promising option for weed control in beans both sole and intercropping systems. Farmers who have used</p>

	pre- emergence (within 24hrs after planting), and post emergence (at 2-4 leaves) have realized the higher yields than manual weeding. Use of herbicides is effective, time and labour saving. There are several registered herbicides (Pesticide Control Board Manual) on the market that can be used by bean growers. Post emergence is applied to control weeds which are existing and actively growing weeds for effective control. Pre-emergence control weed weeds at germination stage or as they emerge from the soil. Herbicides are classified according to their mode application based on time of application, based on action, contact or systematic. In contact it will kill on the part covered by the chemic and is best for annual weeds. The systemic is absorbed by the leaves or roots and then translocate through the plant system to the point of action. Selective and non-selective. Selective will kill some plants and non-selective will kill all.
where already promoted if any	Laikipia, Nyeri
Counties where TIMPs will be upscaled	Laikipia and Nyeri
Challenges in development and dissemination	High cost of herbicides Inadequate knowledge and information on which herbicides to use and when to use them Myths on appropriateness of using herbicides
Suggestions for addressing the challenges	Promotion of the product by conducting demos and field days and involvement of the stakeholder e.g. agro-chemical company Develop and disseminate information to various stakeholders Training on integrated approaches using available methods, including appropriate herbicides and their use of herbicides – safety
Lesson learned in up scaling if any	That integrated approaches of weed management are more effective than use of one control method and is safe on environmentally friendly. Continue use of herbicide is environmental, health and social hazard.
Social, environmental, policy and market conditions necessary for development and up-scaling	Train on understanding the working of an integrated weed management. Have an environmental and safety plan when using herbicides Address the environmental and social concerns related to use of agrochemicals. A functional agrodealer network to supply the products when required by the farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Ksh 4000
Estimated returns	KSH 1000 per acre
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • IWM is labor intensive in terms of handling and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land than men. • Women and youth may also have limited access to inputs such as manures and

	<p>chemicals than men.</p> <ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunity exist for women to access the required credit through the women enterprise funds. • Employment opportunities exist for youths in spraying the weeds
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land than men. • VMGs may also have limited access to finances to buy the required inputs such as manures and chemicals than men. • VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunity exist for youths to access the required credit through the youths enterprise funds. • Employment opportunities exist for youths in spraying the weeds
E: Case studies/profiles of success stories	
Successstories	
Application guidelinesfor users	Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires	Ready for up scaling
validation;3. Requiresfurther research)	
G: Contacts	
Contacts	Center Director KALRO Kabete, Waiyaki Way, P.O Box 14733-00800, Nairobi
Lead organization and scientists	KALRO , Kabete Dr Hottensiah Mwangi, Dr Jedidah M. Maina, Charity, W. Muchira, Dr. Ruth Amata
Partner organizations	Kenya Seed Company, Faida Seed, Agrosoy seed, NGOs, CBOs, County Governments, KEPHIS

Research Gaps

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

2.4.2. TIMP Name	Land Preparation Practices
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor land preparation contributes to low yield in bean production across the agro ecological zones in Kenya.
What is it? (TIMP description)	<p>Land preparation covers a wide range of practices from zero-tillage or minimum tillage, which minimizes soil disturbance through to conventional ploughing using hand hoe, ox plough or tractor. It typically involves (1) plowing to "till" or dig-up, mix, and overturn the soil; (2) harrowing to break the soil clods into smaller mass and incorporate plant residue, and (3) leveling the field.</p> <p>Other forms of land preparation is through ridging's which can be done manually or mechanized by use of tillers. It is done during the dry weather when soils are easier to work as well as exposing pest and pathogens to the hot sun. We recommended this to be 3-4 weeks before the rain commence. Where herbicides are used, follow the manufacturers labe and recommendations specific to each herbicide. Apply post emergence on vigorously growing weeds to clear the perennial weeds such as couch grass, nut grass among others. The most common herbicides used is Glyphosate with trade names such as Round up, Glycel, Kausha, weedal. production include grass weeds such as couch, kikuyu grass, star grass and annual weeds such as black jack, gallant soldier, mexican marigold and wandering jew. Different weeds require various strategies for effective control, hence the advantage of combining the various management strategies. Significant yield losses in bean production are attributed to poor weed management. Proper weed management is necessary to increase productivity.</p>
Common weeds affecting beans production	



Wandering Jew
(*Commelina Benghalensis*
L.) Source Hottensiah
Mwangi



Double thorn (*Oxygonum sinuatum*
(Meisn.) Dammer associating with crows
foot (*dactyloctenium aegyptium*) and
Ragwort (*Senecio discifolia* Oliv.) Source
Hottensiah Mwangi



Gallant soldier (*Galinsoga*
parviflora Cav.)



Blackjack (*Bidens pilosa* L.)



Digitaria velutina (Forssk.)P. Beauv.



Wild finger millet (*Eleusine indica* (L.)Gaertn.)



Purslane (*Portulca oleraceae* L.)
Source Hottensiah Mwangi



Late weed (*Trichodesma zeylanicum*)
amonggrass weeds Source Hottensiah Mwangi



Goat weed (*Ageratum conyzoides* L.)



Sow thistle (*Sonchus oleraceus* L.)



Terere (*Amaranthus graecisans*)



Oxalis (*Oxalis latifolia* H.B.K)



Chickweed (*Stellaria media* (L.) Vill.)



Wild lettuce (*Launaea cornuta* (Oliv.&Hiern))



Parthenium
(*Parthenium
hysterophorus*)



Thorn apple (*Datura stramonium* L.)



Asthma weed (*Euphobia hirta* L.)







Wild raddish (*Raphanus raphanistrum*)



Starbur (*Acanthospermum hispidum*
DC.)



Eshaaga (*Eracustrum arabicum* Fisch &
Mey.)

		
	Chinese Lantern (<i>Nicadra physaloides</i>)	Tar vine (<i>Boerhavia diffusa L.</i>)
		
	Nutsedge (<i>Cyperus rigidifolius</i> Steud.) Source: Hottensiah Mwangi	Couch grass (<i>Digitaria abyssinica</i>) Source: Hottensiah Mwangi
Justification	Land preparation is important to ensure that the bean field is free of weeds and ready for planting because weeds are sensitive and poor competitors. It must be deep enough to cover the seed well and also increase absorption of moisture. A well-prepared field also facilitate in obtaining a uniform crop depth resulting to almost uniform germination. It controls weeds, recycles plant nutrients, and provides a soft soil mass suitable for direct seeding.	
B: Assessment of dissemination and scaling up/out approaches		
Users of TIMP	<ul style="list-style-type: none"> • Farmers in the region 	
Approaches used in dissemination	<ul style="list-style-type: none"> • Demos and field days 	
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Conduct demos • Organise the field days with farmers groups and stakeholders • Provide communication products eg brochures 	
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • County extension staffs, • Tractor/Plough service providers, • NGOs, • Research organization (KALRO, CIAT) 	
• C: Current situation and future scaling up		
Counties where already promoted if any	<ul style="list-style-type: none"> • Conservation Agriculture/Minimum Tillage in laikipia, Nakuru, • Tractor ploughing in Nakuru, Laikipia, Trans Nzoia, Bungoma, Bomet, Narok, Nandi, Kakamega • Oxen and hand hoe ploughing: Across all counties 	
Counties where TIMPs will be Upscaled	<ul style="list-style-type: none"> • Laikipia and Nyeri 	

Challenges in development and dissemination	<ul style="list-style-type: none"> • Low mechanization of bean growing systems • Small land holding limiting tractor mechanization • High cost of using mechanized options
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Promotion of the low cost mechanization technologies where possible. • Tractor hire service by County and other service providers • Adoption of minimum tillage options
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Good land preparation results to increased yield and moisture retention especially where ridging is practiced and the rainfall is low
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Land size and topography influences potential for mechanization • County tractor subsidy program can help promote mechanization • Use of small hand tractors are affordable and easier to operate
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KeS 4,500 per acre
Estimated returns	<ul style="list-style-type: none"> • KeS 6000-7000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Use of low cost land preparation technologies that are affordable to women farmers • Promote labour saving technologies to benefit women who are major players on land preparation • Land preparation during dry period to ensure drying of weeds making subsequent operations easier and cheaper. • Early land preparation exposes the pest and diseases to the hot sun hence reduced build up of inoculum • Explore use of herbicides to kill weeds and save labour
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for using low cost, low labour land preparation technologies to benefit women.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • High cost of land preparation • Access to the mechanized options for land preparation. • Some management practices such as Conservation Agriculture (CA) is friendly to the VMGs • The project has provision on training of the youths
VMG related opportunities	<ul style="list-style-type: none"> • Group land preparation by VMG • There is a business opportunity for the youth using low cost mechanization- e.g. ox-ploughs, walking tractors in land preparation service enterprises
E: Case studies/profiles of success stories	
Success stories	Farmers in Embu and Nyeri have realized higher returns after this practice and have attained Lucy Waihiga who
	increased yield from 45-180kg from ¼ acres
Application	The small walking tractors are available in the Counties and training on use of

guidelines for users	small equipment and mechanization
F: Status of TIMP Readiness	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO Katumani, KALRO Embu
Lead organization and scientists	KALRO Katumani
Partner organizations	KALRO, CIAT-PABRA, Seed Companies, Mechanization partners e.g. Ikonic, Hello Tractor, Conservation Tillage Network in Nairobi

2.4.3. TIMP Name		Optimum Plant Spacing
Category (i.e. technology, innovation or management practice)		Management practices
A: Description of the technology, innovation or management practice		
Problem addressed		Plant density is important factor on bean production to reduce space for weeds. However, some farmers are not keen on this and they end up using wide spacing leading to much space for weeds and a lot of labour required weeding. Others use high plant densities resulting with heavy forage with little pods and unnecessary high seed rate with low yields.
What is it? (TIMP description)		Using the correct spacing to achieve a optimum population. Plant density has effect on various factors such as weed, surface evaporation, light interception, development of right number and size of pods. Selecting the optimal row spacing is important to improve crop productivity. Poor spacing results in low plant population, high weed density and hence lower yields. On the other hand overcrowding of crops may reduce yields and it may also lower quality of the grain produced because of competition for light and soil nutrients Proper spacing will suppress weeds and increase yields.
Justification		Using the correct spacing will give a good population and the canopy will suppress all weeds emerging later. Overcrowded beans reduce yields due to intra competition while weeds-beans will have inter competition for light and soil nutrients lowering quality and quantity of the grain produced. Optimum plant spacing aims to fully exploit land by getting the best yields and at the same time sustain the soil productivity. Proper plant spacing requires less seed as it ensure the optimal density resulting to higher yield. Most dry bean varieties that released by Research Organization (KALRO) and the Universities recommend a inter and intra row spacing of 50cmx10cm (one seed per hill) with a seed rate between 25-30kg/acre depending on the seed size. The seed are placed between 3-5cm below the soil surface which is adequate enough to prevent the sun scotch at the same time allows proper crop emergence. Proper spacing allows beans to

	get sufficient light and nutrients therefore increasing yield.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, Seed producers, Research organizations universities and • Extension Agents (Public and Private)
Approaches used in dissemination	<ul style="list-style-type: none"> • Extension publications (posters/ brochures/leaflets) • Partners -NGOs Demonstrations and field days, Agriculture
	<ul style="list-style-type: none"> • shows/trade fairs and distribution of small sample, farmer participatory evaluations Seeds of Gold, Mass Media – e.g. Mkulima programme, Smart Farmer
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of seed • Biological knowledge on weeds • Conduct demos and the field days with farmers groups and stakeholders Capacity building on the importance of i n t e g r a t e d w e e d m a n a g e m e n t .
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • County extension staffs, NGOs, Private sectors e.g. seed company, Research institutions, Universities and bean value chain service providers
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Altitude area of 1500-2000 meters above sea level Bomet,Nakuru, Laikipia, Nyeri
Counties where TIMPs will be up-scaled	<ul style="list-style-type: none"> • Laikipia and Nyeri
Challenges in development and dissemination	<ul style="list-style-type: none"> • Inadequate and tested low cost been seeding equipment Inadequate information to stakeholders on optimal spacingoptions for the different varieties for the different AEZ
Suggestion for addressing the challenges	<ul style="list-style-type: none"> • Adapt simple seeding equipment to mechanize bean production Train the youths (artisan) to fabricate planting equipment for thefarmers and the stakeholders. • Conduct demos and field days to demonstrate on benefits of correct spacing which can be done through use Farmer Field Business School (FFBS) and Agricultural Innovation Platforms (AIP)
Lesson learnt in scaling, if any	<ul style="list-style-type: none"> • Farmers who have learnt of the technology through field days and demos are currently user of the new technology. Alternative method (mechanization - planter) may lessen the work • Capacity building and awareness campaign on proper spacing are required.
Social, environmental, policy and market conditions necessary for -development and up-scaling	<ul style="list-style-type: none"> • The technology have no negative impact on the environment and therefore can be developed and up-scale. • The practice minimizes the use pesticides and surface run off especially where the beans are planted in ridges
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • This is a low cost management practice although it has a limitation of using herbicides. The weeds are however minimal because of the ground cover.
Estimated returns	<ul style="list-style-type: none"> • If the focus is business oriented and mechanization is employed it

	may bring the cost of production lower.
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the crops planting activities therefore the management practice may increase their work burden • Women and youth have limited access to education, training and extension services on the management practice than men. • Women have less access to agricultural information, technology and knowledge on the management practice.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the management practice.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to training and extension services on the management practice. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women in performing the management practice.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • Some farmers in Kieni in Nyeri County have moved from 1 bag to 4 bags (90kg bag). Some Embu farmers have reported improved moisture retention when the plant beans in rows and in correct spacing where the ridges are done
Application guidelines for users	<ul style="list-style-type: none"> • Extension and training material available such as brochure
F: Status of TIMP Readiness	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO EMBU Po Box 27 60100 Embu Kalro.embu@kalro.org
Lead organization and scientists	KALRO Catherine M.
Partner organizations	Kenya Seed Company, Agrosoy seed ,NGOs, CBOs, County Governments, KEPHIS

2.4.4 TIMP Name	Legume Intercropping System
Categories (i.e. technology innovation Or management practice)	Innovation



Legume sorghum intercrop

A: Description of the technology, innovation or management practice

<p>Problem addresses</p>	<p>Weeds invading the bean fields competing for resources nutrients, water and space. Planned inter-cropping of beans with other crops - cereal (maize or sorghum) tubers (cassava), bananas, cash crops (coffee) gives returns. Poor intercropping results in low yields attributed to competition for light and nutrients and may lead to increased infestation of pests and diseases. Good intercropping to effectively control weeds requires specific spacing, the right variety of legume depending on growth habit of the intercrop.</p> <p>Innovative intercropping systems can help farmers achieve the desired yield gains while at the same time diversifying the cropping system and adapting to climate change. This will require understanding the optimal crop spacing and configuration, selection of varieties adapted to intercropping and adopting sequencing approaches that will maximize use of the resources (water, nutrients and light) without causing undue competition.</p>
<p>What is it? (TIMP description)</p>	<p>Innovative Legume Intercropping Systems is the application of growing more than one crop in a field at the same time, as a tool to enhance agricultural production and to obtain efficient land use. Intercropping systems are defined based on the temporal and spatial arrangements of the crops. There are several intercropping systems such as mixed, strip, row intercropping patterns, Relay and Alley intercropping.</p> <p>Farmer's common intercropping system involves planting beans in same hole as maize or between the maize interrow spacing of 0.75m. Innovative intercropping systems involve arrangement with staggered 1-by-2 or 2-by-2 configuration between the cereal (maize) and beans, respectively. More complex intercropping systems with more than 2 crops have also been tested.</p>



Innovative Sorghum bean intercrop



Bean Sorghum Innovative intercropping



Bean-millet-sorghum intercrop

Justification

Cropping of several plant species together reduces negative effects of a

monoculture and thus is commonly employed in ecological agricultural systems. Agricultural practices like intercropping are pro ecological; supporting bio-diversity and is compatible with the principles of balanced agriculture. Intercropping systems provide better soil cover hence reducing weed incidences. Intercropping has important advantages in regard to efficient land use, increasing crop productivity and monetary returns thanks to effective use of various inputs compared to sole cropping. It can significantly increase total productivity as compared to sole cropping thanks to better utilization of water, nutrients and solar energy. Crops in these systems use available resources more efficiently thanks to different rooting and canopy properties which component plants species exploit resources complementary. Intercropping systems can cause more effective use of resources by providing symbiotic nitrogen from legumes, or making available inorganic phosphorus fixed in soil because of lowering of pH via nitrogen fixing legumes. Intercropping systems is a climate adaptation strategy in case of crop failure in mono cropping and is considered as one of the most dependable ways to maintain the sustainability of crop production. It is a risk mitigation strategy by farmers in light of prevailing climate change. Intercropping practices can ensure higher yield as well as productivity and profitability in crops per unit land. Intercropping systems with a Land Equivalent Ratio (LER) of 1:2 are considered better at using resources and profitable than mono-cropping systems. Spatial regulations, physical and temporal barriers, microclimate modification, odor effects, and color and trapping effects between intercrops influence insect or disease situation or their natural enemies. Crop rotation and intercropping practices decrease weed population density and biomass yield. Success of intercropping systems over sole cropping can be achieved by careful agronomic manipulations. These manipulations can be planting time, plant density, available resources and intercropping patterns. Spatial arrangements, planting and harvest times of crops should be taken into account in intercropping systems.

B: Assessment of dissemination and scaling up/out approaches

Users of TIMP	<ul style="list-style-type: none"> Farmers, Extension Staff
Approaches used in dissemination	<ul style="list-style-type: none"> Demos and field days
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> Conduct demos band the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> County extension staffs, NGOs, Private sectors e.g. seed company, Research organizations (KALRO, Egerton University, UoN, CIAT-PABRA)

C: Current situation and future scaling up

Counties where already promoted if any	<ul style="list-style-type: none"> Altitude areas of 1,500-2,000 above sea level ie Bomet Nakuru, Laikipia, Nyeri, Bungoma, Kakamega, Siaya, Trans Nzoia, and Uasin Gishu
Counties where TIMPs will be up scaled	<ul style="list-style-type: none"> Nyeri and Laikipia

Challenges in development and dissemination	<ul style="list-style-type: none"> Inadequate training and limited extension staff
Suggestion for addressing the challenges	<ul style="list-style-type: none"> Facilitation of training of county extension staffs Contact demos and field days
Lesson learned in up scaling if any	<ul style="list-style-type: none"> Intercropping systems are knowledge intensive and require making adjustments in traditional ways of cropping. Such a change calls for intensive training and demonstration for farmers to familiarize with the technology and its benefits. There is need to adapt the technology when promotes in new environments/AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> A farmer learning platform is essential for training on how to deploy the technology
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	-
Estimated returns	-
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> 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. Women have less access to information, technology and knowledge. Women have less access to land and credit that can be used for dry beans farming than men. Women have limited access to education, training and extension services than men.
Gender related opportunities	<ul style="list-style-type: none"> Intercropping offers good opportunities women to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to agricultural information, technology and knowledge. VMGs have limited access to productive resources such as land and credit for dry beans farming. VMGs have limited access to training and extension services. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> Intercropping offers good opportunities to VMGs to grow diverse crops for economic gains and at the same time offers enhanced biodiversity benefits.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> MBILI-MBILI system work in Bungoma, Kakamega, Siaya, Trans

	Nzoia, and Uasin Gishu
Application guidelines for users	<ul style="list-style-type: none"> • Extension and training material available
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Require validation
G: Contacts	
Contacts	<p>Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-721822312 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M. Maina, Charity W. Muchira
Partner organizations	County Extension Staff, Farmer Groups and CBOs, NGOs

2.4.5. TIMP Name	Mulching for weed control
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Weeds infestation, soil moisture and loss of organic matter, in ASAL.
What is it? (TIMP description)	The practice of covering the soil/ground with natural materials or synthetic materials to control weeds from seeds that germinate near or at the soil surface. There are two types of mulches: biodegradable or natural mulches. Biodegradable include straw, dead leaves and compost to make more favourable conditions for plant growth, development and efficient crop production. The mulches should be between 2-4 inches deep to be effective. Non degradable or synthetic mulches can be used in growing of climbing beans. Only black mulches should be used to control weeds. Organic mulches retain moisture in the soil; suppress weeds; keep the soil cool; and help improve soil fertility (as the mulches decompose) and improves microclimate hence increasing biodiversity. Synthetic mulches will solarize soils, control weeds and weed seeds, retain soil moisture and controls diseases.
Justification	Organic mulching has added benefits other than minimizing weeds infestation, it facilitates retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and

	ultimately enhances the growth and yield of crops. It also improves soil; structure directly by preventing raindrop impact and indirectly by promoting biological activity. Synthetic mulch are easy to obtain and apply, and are reusable and effective in weed control.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer field schools • On-farm demonstrations during farmer field schools • Training in workshops
Critical/essential factors for successful promotion	<p>Organic:</p> <ul style="list-style-type: none"> • Availability of plant or crop residues for organic mulches. • Size of the land. • Competing uses of crop residues. • Type of the crop <p>Synthetic</p> <ul style="list-style-type: none"> • Cost of materials • Disposal of material after use.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services; Provide link with • Farmers • Community farmer groups; play coordination role for ease in problem identification and dissemination
C: Current situation and future scaling up	
Counties where already promoted	<ul style="list-style-type: none"> • Not used in beans in Kenya. Used in Thailand.
Counties where TIMP will be promoted	<ul style="list-style-type: none"> • Where beans are a priority value chain. All the other 17 counties
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of enough plant and crop residues due to competing uses in organic mulches. • Possibilities of insect build up categorized as pest or disease vectors or weed seeds in organic mulches.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Crop diversification to increase availability of organic mulches. • Establish and follow a good integrated pest control management program for the particular beans.
Lessons learned	<ul style="list-style-type: none"> • There is need to adapt to alternative mulching technologies in addition to use of organic materials like crop, plant residues.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Practice is socially acceptable • Environmentally friendly • Increased productivity will provide supply to the markets • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Organic mulch is low cost but labour intensive during the initial application.
Estimated returns	<ul style="list-style-type: none"> • 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"> • The TIMP will reduce women's weeding time that can be used performing other productive activities.

Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for the unemployed youths in performing the operation. • Opportunities exist for women to use the readily available on-farm mulch, to enrich their crop for increased productivity.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The TIMP will reduce some VMGs weeding time that can be used in performing other productive activities. • Mulching is labour intensive for some VMGs such as the elderly hence may not to be adopted.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for the unemployed youths in performing the operation.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • Farmers in different value chains have reported improved soil conditions, reduced runoff and nutrient loss, soil moisture retention in the soil and generally increased crop production following application of mulching technology.
Application guidelines for users	
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further Research)	1: Ready for upscaling
G: Contacts	
Contacts	<p>Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira
Partner organizations	County governments

Research Gaps:

Determine cost benefits of using biodegradable biological and plastic mulch versus other weed management strategies in bean production

2.4.6 TIMP Name	Chemical Weed Control
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Heavy weed infestation in beans fields
What is it? (TIMP description)	Chemical weed control refers a technique that involves the application of herbicide to control the growth weeds or to soil to kill emerging weeds and/ or weed seeds. Herbicide


	<p>technology requires knowledge on herbicides required for specific crops and weeds occurring in the cropping system.</p> <p>Recommended herbicides;</p> <ol style="list-style-type: none"> 1. Lasso 50% EC @2.0 L/Ha 2. Trifuralin @ 2.5 litre/Ha <p>To be done within 3 DAS in 500 litres of water/Ha on moist soil.</p>
Justification	Manual hand weeding is very labour intensive, scarce and expensive. Use of herbicides reduces drudgery and effects can be timely weed control.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers and extension agencies
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations, training on safe use of chemicals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building and training on safe use of chemicals for all users
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Public and private partners –[MOALF&I] for extension, • Chemical companies for back stopping • ICRISAT for technical backstopping and promotion; • FIPs (Farmer Input Promotion) for promotion • Farmer Groups for activity implementation and promotion • Service provider agencies e.g. Micro- finance agencies and banks for credit provision, agro-vets for input supply. • Processors and manufacturers to create market for produce, aggregators e.g. CARD (Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, nutrition training etc.
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Limited use of herbicide among small scale farmers
Counties where TIMP will be promoted	<ul style="list-style-type: none"> • Herbicide weed control will be upscaled in all the areas where beans are being grown.
Challenges in dissemination	<ul style="list-style-type: none"> • Limited knowledge and information and • Low literacy levels among the farmers. • Herbicide use and application requires knowledge and training on safe use of herbicides. • The farmers need to understand the proper use and application of herbicides to avoid buying the wrong herbicides.
Recommendations for addressing	<ul style="list-style-type: none"> • There is need to train the agricultural extension county officers as TOTs on safe use of herbicides. This help in reaching the farmers with the information. Herbicides like all chemicals have to be used with care to avoid environmental and social hazards. Liaise with the Agricultural extension and environmental officers on the

	<ul style="list-style-type: none"> ground for guidance on safe use of chemicals
Lessons learned	<ul style="list-style-type: none"> Access to and use of information on different methods of weed control will reduce drudgery and cost of weed management. It could give room to increase area under cultivation and increase productivity.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> Sensitization of communities on alternative methods of weed control and safe use of chemicals is very necessary.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> Herbicide use is cheaper than manual weed control because it requires less labour.
Estimated returns	<ul style="list-style-type: none"> Not yet estimated
Gender issues and concerns in adoption and scaling up	<ul style="list-style-type: none"> Women have less access to inputs such as chemicals. Technology is not safe for use by expectant women and the physically challenged because of its hazardous/dangerous nature Women have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> 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.
VMGs issues and concerns in development and dissemination	<ul style="list-style-type: none"> VMGs have limited access to education, training and extension services. Women have less access to inputs such as chemical. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due to lack of awareness.
VMGs related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for youth males and men in spraying.
E: Case studies/profiles of success stories	
Success stories	.
Application guidelines for users	<ul style="list-style-type: none"> Weed control leaflets/ manuals. Information and instructions always displayed on the labels attached to containers on how to use.
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Requires validation; 3.Requires Research)	Requires validation and more research
G: Contacts	
Contacts	

Lead organization and scientists	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-0721822312 E-mail: cd.narl@kalro.org
Partner organizations	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira

Research Gaps:

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

2.4.7 TIMP Name	Mechanical Weeding
Category (i.e. technology, innovation or management practice)	Technology
	 <p style="text-align: center;">Motorized weeder (Source; cnsprayers.en.made in china.com)</p>
A: Description of the technology, innovation or management practice	
Problem addressed	Weeding labour and timeliness in Weed management.
What is it? (TIMP description)	Plant clean certified seeds in weed free well prepared ground Planting to be done in rows to facilitate interrow weeding. Two weedings at 15 and 30 days after sowing(DAS) 2) Row Weeders (Manual/ motorized) These implements are used to weed between the rows. The intra row weeds are removed byhand pulling.
Justification	Weeds if not controlled will cause yield losses due to competition. They harbour other pests (insects and diseases). Lower quality of the produce.
Region promoted	<ul style="list-style-type: none"> All areas where beans grown
Counties where TIMP will be upscaled	<ul style="list-style-type: none"> All counties growing beans
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> Farmers and Agricultural extension officers

Approaches used in dissemination	<ul style="list-style-type: none"> • On-farm experimentation. • Field days, • Shows, • Farmer to farmer communication, • Leaflets, • Larger plot demonstrations.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Participatory Implementation, stakeholdersensitization.
Partners/stakeholders for scaling up and their respective roles	<ul style="list-style-type: none"> • Public and private partners –[MOALF&I] for extension, • Jua Kali artisans • Processors and manufacturers to create market for produce, aggregators e.g. CARD(Community Action for Rural Development) for economy of scale sales and marketing], and Others e.g. NGOs, CBOs, and FBOs to provide specialist services like community mobilization, • Nutrition training etc.
C: Current situation and future scaling up	
	<ul style="list-style-type: none"> • Limited research done on gender responsive weeding implements i.e row weeders are heavy and can only easily be handled by men
Challenges in dissemination	
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Work with Jua Kali industries for fabricationof appropriate implements.
Lessons learned	<ul style="list-style-type: none"> • Access and use of technologies will provide timely weed control which will enhance crop production.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Sensitization of communities on the available technologies and management practices in weed management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Basic cost of the weeder (implement is high - 28,000 for ordinally bean farmers, they can purchase as a group.
Estimated returns	<ul style="list-style-type: none"> • Not yet estimated
Gender issues and concerns in development ,dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the crops weeding activities therefore the TIMP will reduce their work burden • Women and youth have limited access to credit to purchase the required implement. • Women and youth have limited access to education, training and extension services than men. • Women have less access to agricultural information,

	technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the operation.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the implement. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • VMGs have limited access to information on production techniques. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in performing the operation.
E: Case studies/profiles of success stories	
Success stories	Not yet accessible to bean farmers.
Application guidelines for users	Production manuals to include weed management TIMPs
F: Status of TIMP Readiness (1. Ready for up-scaling; 2. Validation 3. Requires further research)	1: Ready for up-scaling
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira
Partner organizations	ICRISAT Nairobi; MoALF in Counties

Research Gaps:

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

2.4.8 TIMP Name	Safe Use of Agrochemicals
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem addressed	Excessive pesticides application to crops, use of pesticides for spraying crops without wearing the right protective clothing, storage of pesticides in non-designated stores, wrong application techniques, spraying at the wrong times and against the wind direction, use of pesticides without following the guidelines provided on the labels. Inadequate enforcement of global policies and regulation on use of pesticide. Environmental, health and social concerns.
What is it? (TIMP description)	Capacity building of farmers, crop protection teams on safehandling and use of pesticides right from transportation from the agro-dealers to storage in their houses, mixing procedures and their application in the field in order to ensure safety of the crop, the person handling them and the environment at large. The technology will include proper methodologies for proper pesticide disposal to minimize pollution of the environment.
Justification	Although cases of improper use of pesticides are very common in most of the areas where maize is grown, they are not documented. There have been incidences of excessive use, improper handling that lead to the spray operators inhaling the chemicals in the process of spraying, use 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 pesticides. There has been reports of increase of chronic diseases in human beings
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers, Bean Seed Producers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer trainings, farmer participatory demonstrations/ farmer field schools, shows, trade fairs, Plant clinics, Pesticides spray Demonstrations
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Collaboration between all partners, willingness of farmers to adhere to proper guidelines • Adequate facilitation: funds, logistics (transport)
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • 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 maize production, KALRO and Universities to develop the technologies and conduct ToTs. CABI, AAK, PCPB, KEPHIS
C: Current situation and future scaling up	
Counties where technology is already being promoted if any	<ul style="list-style-type: none"> • Nakuru, TransNzoia, Kakamega, Bungoma, Machakos, Makueni, Nyeri, Laikipia
Counties where TIMPS will be up scaled	<ul style="list-style-type: none"> • Nyeri and Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> • Change of mindset in favour of current practices maybe difficult to achieve,

	<ul style="list-style-type: none"> • Illiteracy and inadequate capacity to use pesticides correctly. Most farmers cannot read and interpret the labels properly resulting to overuse or underuse of pesticides • Use of banned pesticides from neighboring countries • Inadequate capacity by farmers and agrochemical companies to dispose pesticides properly
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Capacity building and sensitization forums for both farmers and agro dealers using participatory approach • Formation of youth spray teams • Establishment of aggregation centres for pesticide containers • Establishment of training of Extension staff and lead farmers as TOT • Increase surveillance along the border points and enforce the laws
Lessons learned in upscaling if any	<ul style="list-style-type: none"> • Upscaling of this technology needs young men and youth due to its hazardous nature. Some of the aspects of this technology need a lot of capital to actualize. For instance, the collection and incineration of pesticide containers needs a lot of money that may not be accessible by most men or youth groups. The illiteracy levels of some farmers may hinder the use of correct information/knowledge in the use of pesticides in some areas.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Organized collective marketing channels critical for benefits to be derived from practice
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 60,000 per acre
Estimated returns	KES 500,000 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The management practice will reduce the health hazards associated with agro-chemicals especially women • Women have less access to agricultural information, technology and knowledge. • Pesticides and protective gear are expensive and most women and youths may not afford them • Women have less access to education. Consequently, their high levels of illiteracy and inability to read and interpret the content of the pesticides labels especially on re-entry period after spraying and PHI. This causes their pesticides poisoning
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males to form spray teams that perform the task of spraying
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The management practice will reduce the health hazards associated with agro-chemicals especially some VMGs such as women • VMGs have less access to agricultural information, technology and knowledge. • Pesticides and protective gear are expensive and for some VMGs to afford • Some VMG such as women have less access to education. Consequently, their high levels of illiteracy and inability to read and


	interpret the content of the pesticides labels especially on re-entry period after spraying and PHI. This cause their pesticides poisoning
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some VMGs such as the youth males to form spray teams that perform the task of spraying
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • The AAK has trained youth spraying teams that have helped in the spraying of the farms in a few counties thus reducing cases of people being exposed to pesticides • There are reported cases of farmers who regularly scout their crop that have reported to using less pesticides on their farm • Some counties who have aggregation centres by AAK for collection of pesticide containers. This has led to reduction of these containers on farms • Safe use of Pesticide campaigns by AAK, PCPB KALRO and MOLFI have
Application guidelines for users	<ul style="list-style-type: none"> • Sensitization of farmers on the harmful effects of the pesticides on human beings and environment. Capacity build farmers and youth on spraying techniques using developed curriculum by AAK and PCPB. Assist youth to form spraying teams and equip them with PPEs. Train Extension staff as Plant doctors using the CABI modules, manuals and establish Plant Clinics in the target counties. Develop and equip the Plant Doctors and youth spraying teams with pest decision guidelines, manuals, brochures developed by KALRO and CABI as reference material
Status of TIMP readiness(1. Ready for upscaling; 2. Requires validation; 3. requires further research)	Ready for upscaling;
F: Contacts	
Contacts	<p>Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-721822312 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO, Dr Hottensiah Mwangi. Dr Jedidah M.Maina, Charity W. Muchira
Partner organizations	MoALFI, CABI, PCPB, AAK, KEPHIS, County Governments, Universities

Research Gaps:

Management of troublesome perennial grass weeds and sedges in beans.

2.4.9, TIMP Name	Bean Rhizobium Inoculation Technologies
Category (i.e. technology, innovation or management practice)	Technology

A: Description of the technology, innovation or management practice

Problem to be addressed	Low bean productivity
What is it? (TIMP description)	 <p>Bean Rhizobium Inoculation technology is a legume bio-fertilizer that contain a highly competitive and effective rhizobia strain capable of forming a symbiotic relationship with a specific legume there by fixing nitrogen. Legumes crops generally utilizes atmospheric nitrogen through nitrogen fixation in the root nodules. The naturally occurring strain is not adequate prompting the use of inoculation.</p>
Justification	<p>Nitrogen is usually the most limiting nutrient in crop production in many countries including Kenya. Legumes such as bean require starter nitrogen at planting before it start fixing its own from the atmosphere. Majority of the farmers in Kenya who grow beans for subsistence rarely use to fertilizers. Use of rhizobia inoculants is therefore an alternative approach to improving nitrogen content in the soil. It is a cheaper alternative use of chemical fertilizers when boosting bean production. It is also efficient in the provision of sustainable ecosystem. Seed inoculated with rhizobium exhibits improved nodulation and nitrogen fixation, vigor and overall productivity. Such a health crop is also able to tolerate disease attack. Research has shown that use of rhizobium inoculation on beans can result in doubling or even tripling of bean productivity. Crops grown in rotation benefit from nitrogen fixed after use of rhizobium inoculation to the legume.</p>

B: Assessment of dissemination and scaling up/out approaches

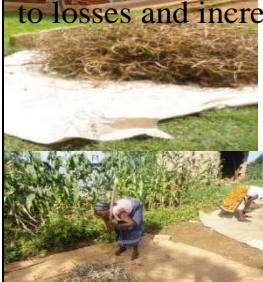
Users of TIMP	<ul style="list-style-type: none"> • Farmers and seed producers; Extension workers, Agrodealers
Approaches used in dissemination	<ul style="list-style-type: none"> • Field demonstrations, field days, promotional materials given in small packages for farmers trials
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Farmer awareness of benefits of rhizobium inoculation • Knowledge on how best to use the inoculant • Conduct on-farm demonstration
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • Rhizobium private producers (University of Nairobi, MEA Ltd) • imited), Agro input dealers and their networks e.g. KenyaSeed, Research organizations (KALRO, CIAT-PABRA, Universities) and Egerton University,

C: Current situation and future scaling up

Counties where already promoted. if any	<ul style="list-style-type: none"> • Nyeri, Kakamega, Nakuru, Bungoma, Transnzoia
Counties where TIMPs will be up-scaled	<ul style="list-style-type: none"> • Laikipia, Nyeri
Challenges in development and dissemination	<ul style="list-style-type: none"> • Limited knowledge on the technology and how to use it. Limited

	supply of the rhizobium products such as Biofix especially in the rural area and storage of the same especially where there is no electricity
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Farmer training and demonstrations Strengthening linkage with private sector and agrodealers to demonstrate the TIMP
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> The technology response varies from one region to another. So needs validation with farmers across the different AEZ
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> Social: Awareness creation about the TIMP considering that it is generally unknown. Environmental: Create awareness that the TIMP improves soil health by increasing bacteria in the soil. Market: Avail the technology to agro-dealers. Policy: Create awareness on soil health improvement and promote use of biological materials as fertilizer.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> The product's target of the smallholder farmers is reflected in its smaller packaging quantities. Rhizobium products are available in small packs: 10g, 50g, 100g and 150g. The smaller pack of 10g retails at about Sh40 and is enough for 1kg of seeds while the larger package of 150g retails at about Sh450.
Estimated returns	<ul style="list-style-type: none"> Rhizobium inoculation eliminates the use of top dressing fertilizers cutting the cost of farming by about 50 percent and depending on the type of crop that is inoculated. Use of rhizobium can result in doubling of yields.
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> Women have less access to credit to purchase the required inputs such as bean rhizobium inoculation bio-fertilizers Women have less access to agricultural information, technology and knowledge on the required bio-fertilizers than men..
Gender related opportunities	<ul style="list-style-type: none"> Affirmative action opportunities such as the women and youth funds exists for women to access the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to credit to purchase the required inputs such as the bean rhizobium inoculation bio-fertilizers VMGs have less access to agricultural information, technology and knowledge on the recommended bio-fertilizers than men.
VMG related opportunities	<ul style="list-style-type: none"> Affirmative action opportunities such as the women and youth funds exists for women to access the required credit
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> Use of rhizobium inoculation (Biofix) was successfully evaluated and found to be effective in western Kenya under the N2Africa Project by CIAT and IITA.
Application guidelines for users	<ul style="list-style-type: none"> User guides accompany the product. Posters and manuals available on use of rhizobium technologies

F: Status of TIMP Readiness	<ul style="list-style-type: none"> Nyeri and Laikipia are new environments where validation of the rhizobium technologies is needed.
G: Contacts	
Contacts	CIAT Nairobi; KALRO Kitale, KALRO Embu
Lead organization and scientists	Dr. Boaz Waswa (CIAT-PABRA), Keziah Ndungu and Catherine Mureithi (KALRO),
Partner organizations	Rhizobium private producers (University of Nairobi, MEALimited), Agroinput dealers and their networks e.g. KenyaSeed, Research organizations (KALRO, CIAT-PABRA, Universities)

2.4.10 TIMP Name	Physiological maturity index and Harvesting
Category (i.e. technology, innovation or management practice)	Management practices
A: Description of the technology, innovation or management practice	
Problem addressed	Poor harvesting technique results to crop loss due to chattering. Poor time of harvesting result to yield loss resulting from attacks from the pests and poor quality. Beans requires to be harvested when they are dry using proper recommended technologies of harvesting and handling
What is description)	<p>Dry beans from the field to the assigned area where they are heaped dried further or transported to the household. In Kenya majority of the farmer harvest their crop manually while a few uses mechanization. Depending on the various varieties bean are ready for harvesting between 75-90 days after sowing. A mature plants turns yellow to brown in colour or the plant falls which are some of the maturity indices. Pods are harvested when they completely dry or they can be harvested when the they have withered but continues to be sun dried. To avoid the loss at harvest it recommended to use Tapirine to prevent the loss of chattered grain. The grain moisture content ranges between 20-25% and the feels firm to touch. If the crop is harvested too early it results to immature unfilled grains that are of poor quality. To maximize on the yield and high quality. Its therefore consider factors such as moisture, colour, days taken from planting. Harvesting too early results in a larger percentage of unfilled or immature grains, which lowers yield and causes higher grain breakage during threshing. Harvesting too late on the other hand lead to losses and increased spillage</p>  <p>Source Catherine Muriithi Plate 1 Beans drying on Tapeline and threshing in plate 2</p>

Justification	Un-proper timing of the harvesting of beans may results to yield loss. This can be either too early resulting to immature unfilled grains that are of poor quality or too late leading to increased spillage and shattering. High moisture content more than 25% may result to rotting of the grain.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Bean producer, Seed producers, Extension staff
Approaches used in dissemination	<ul style="list-style-type: none"> • Extension publications (posters/ brochures/leaflets) • Partners -NGOs Demonstrations and field days, Agriculture shows/trade fairs, farmer participatory evaluations Seeds of Gold, Mass Media – e.g. Mkulima programme, Smart Farmer
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of demonstration materials, Conduct demonstrations and the field days with farmers groups and stakeholders
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • County extension staffs, NGOs, Private sectors e.g. seed company, value chain service provider
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Bomet, Nakuru, Laikipia, Nyeri
Counties where TIMPs will be upscaled	<ul style="list-style-type: none"> • Lakipia and Nyeri
Challenges in development and dissemination	<ul style="list-style-type: none"> • Inadequate and tested low cost bean seeding equipment • Inadequate information to stakeholders on optimal spacing options for the different varieties for the different AEZ
Suggestion for addressing the challenges	<ul style="list-style-type: none"> • Adapt simple seeding equipment to mechanize bean production Train the youths (artisan) to fabricate planting equipment for the farmers and the stakeholders. • Conduct demonstrations and field days to demonstrate proper spacing
Lesson learnt in scaling, if any	<ul style="list-style-type: none"> • Farmers who have learnt of the technology through field days and demonstrations are currently user of the new technology. Alternative method (mechanization – bean harvester) may lessen the work • Capacity building and awareness campaign on method of harvesting
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • The technology have no negative impact on the environment and therefore can be developed and up scaled
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Not determined
Estimated returns	<ul style="list-style-type: none"> • Not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the beans harvesting activities therefore the management practice may increase their work burden Women have limited access to education, training and extension services on the management practice than men.

	<ul style="list-style-type: none"> Women have less access to agricultural information, technology and knowledge on the management practice.
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in performing the management practice.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to training and extension services on the management practice. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities exist for unemployed youth in performing the management practice.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> Some farmers in Kieni and mukurweini have embraced the purchase of Tapelines to loss in Nyeri County.
Application guidelines for users	<ul style="list-style-type: none"> Extension and training material available such as brochure
F: Status of TIMP Readiness	1. Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO EMBU Po Box 27 60100 Embu Kalro.embu@kalro.org
Lead organization and scientists	KALRO Catherine M.
Partner organizations	Kenya Seed Company, Faيدا Seed, Agrosoy seed ,NGOs, CBOs, County Governments, KEPHIS

2.5 Soil Fertility Management

2.5.1 TIMP name	Integrated Soil Fertility Management (ISFM)
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to declining soil fertility, low organic matter, poor soil structure leading to food insecurity in Kenya.
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	<p>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.</p> <p>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.</p> <p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Training in workshops • On-farm visits • Farmer field schools (FFS) • On-farm demonstrations (during FFS)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of affordable and quality manure, fertilizers and clean planting materials • 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 • Take into account amount of production resources (i.e. land, money, labour, crop residues) that different farming families are able to invest in.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services; Provide link with farmers. Community farmer groups; play coordination role for ease in problem identification and dissemination.
C: Current situation and future scaling up	
Counties where already promoted if any	<ul style="list-style-type: none"> • Machakos, Busia, Siaya, Kisumu, Kakamega, Tharaka Nithi, Isiolo, Nyeri, Uasin Gishu, Elgeyo Marakwet
Counties where TIMP will be promoted	<ul style="list-style-type: none"> • Nyeri and Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> • Change of mind set in some regions/cultures that organic manure cannot be applied on crops • Misconceptions that chemical fertilizer damage the soils
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness trainings on role of organic manures in crop cultivation • Training and awareness creation on the usefulness of fertilizer applications to clear the misconceptions about fertilizers
Lessons learned if any	<ul style="list-style-type: none"> • For ISFM to succeed, good germplasm/seed/seedlings, e.t.c. is

	required since farmers tend to re-use previous planted materials.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Practice is socially acceptable, • Environmentally friendly, • Increased productivity will provide supply to the markets, • Supporting frameworks/policies are available
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>For a case of using manures when combined with modest amounts of mineral fertilizers:</p> <p>Manure: 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</p> <p>A cart (about 200kg) of organic animal manure will sell at KES 500</p> <p>A hectare needs 10 tons of manure, costing about KES 20,000/=</p> <p>Seeds will cost KES 6,240 per ha.;</p> <p>Fertilizer per ha = KES 16,000</p> <p>Other costs e.g labour pest and disease control per ha= KES 15,000</p> <p>Total estimated costs per ha= KES 51,000</p>
Estimated returns	Returns dependent on beans yields at 2.5 t/ha at a price of 80/= per kg will be KES 200,000. This translates to a profit of about 150,000/= per ha. (60,000/= per acre).t
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • It is labour intensive hence may not be adopted by women who are already overburdened. • Women and youth have limited access to credit to purchase the required inputs such as such as fertilizers than men. • Women and youth have limited access to land for dry beans cultivation than men • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunity exist for women to access the required credit through the women enterprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to land for dry beans cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • It is labour intensive hence may not be adopted by some VMGs who are elderly. • VMGs have limited access to to credit to purchase the required inputs such as such as fertilizers than men.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action in various areas as for instance in the provision of finances to VMGs • Increased production due to use of the TIMP will lead to increased consumption and utilization of dry beans and hence improved health of VMGs
E: Case studies/profiles of success stories	

Success stories	ISFM successes have been reported in dry bean and millet value chains at Machakos where the productivities have been improved
Application guidelines for users	<ul style="list-style-type: none"> • Always use well-adapted, disease- and pest-resistant germplasm/seed to make efficient use of available nutrients. • Ensure that good agronomic practices are upheld • For sustainability, lone use of inorganic or organic materials should be avoided.
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director KALRO Kabete, off Waiyaki way, P.O. Box 14733-00800, NAIROBI. Tel:+254-721822312 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO; E. Gikonyo, D. Kamau, A. Esilaba, J. Ndufa, F. Wandera
Partner organizations	County governments KEFRI

Gaps:

1. Testing paired soil and crop samples to determine nutrients in the soil and what is available to plant.
2. Determine nutrient deficiency and make recommendation for the type of fertilizer to use and application rates.
3. Developing a fertilizer recommendation system with options for new blends.
4. Working with fertilizer companies to produce fertilizer blends packaged in smaller quantities per farmer needs.
5. 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.
6. Updating existing soil maps with newly acquired soil data to provide current soil fertility status in the country.

2.5.2 TIMP name	Integrated Manure Management
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Land degradation characterized by the declining soil fertility, low yields, increased soil moisture stress, increased soil erosion and 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 dry beans.
Justification	<p>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.</p> <p>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.</p> <p>Given the acute poverty and limited access to mineral fertilizers, manure has the potential providing the limiting nutrients and improving the soil health.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches used in dissemination	Open and field days Exchange visits Demonstration farms
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Training on feeding, management and use of manure • Dissemination approach used to reach target farmers • Model demonstration plots using dry beans
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
C: Current situation and future scaling up	
Counties where already promoted if any	Tharaka Nithi, Kajiado, Uasin Gishu
Counties where TIMP will be promoted	Nyeri and Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of model demonstration farms • Cultural challenges • Lack of interest by pastoral communities • Lack of continuity in training of extension staff and farmers in the skill for manure management • Lack of proper mobilization mechanism for reaching many farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establishment of many demonstration plot by counties • Capacity building of pastoral communities on manure management and its benefit • Continuous capacity building of demonstration farmers and extension workers • Use of approaches to mobilize farmer to attend

	demonstration forums
Lessons learned if any	<ul style="list-style-type: none"> • Proper use of manures improves soil fertility • Use of manures enhances crop productivity • Skills in manure preparation, storage and application
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Social: Acceptability of manure as a resource for increasing agricultural productivity in pastoral communities • Environment: Knowledge and awareness creation on pathogens which can be harbored in the manure leading to disease outbreaks to livestock • Markets: Availability of markets and better prices as MM would result in increased output and quality • Policy: Policies that address MM in relation to pathogens and environment (e.g. leaching, GHG emissions) from animal manures.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<p>Manure: 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</p> <p>A cart(about 200kg) of organic animal manure will sell at KES 500</p> <p>UA hectare needs 10 tons of manure, costing about KES 20,000</p> <p>Seeds will cost KES 6,240 per ha.;</p> <p>Other costs e.g labour pest and disease control per ha= KES 15,000</p> <p>Total estimated costs per ha= KES 35,000</p>
Estimated returns	Returns dependent on beans yields at 1.5 t/ha at a price of 80/= per kg will be KES 120,000. This translates to a profit of labour KES 85,000 per ha. (34,000/= per acre).
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • It is labour intensive in terms of handling and application hence may not be adopted by women who are already overburdened. • Women and youth may also have limited access to inputs such as manures than men. • Women have less access to credit to purchase the required inpits like manure than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunity exist for women to access the required credit through the women enterprise funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs may also have limited access to finances to buy the required inputs such as manures than men. • VMGs have less access to credit to purchase the required inpits like manure than men. • VMGs have less access to agricultural information, technology and knowledge than men.

VMG related opportunities	<ul style="list-style-type: none"> Affirmative action in various areas as for instance in the provision of finances to VMGs. Increased production due to use of manure will lead to increased consumption and utilization of dry beans hence improved health of VMGs.
E: Case studies/profiles of success stories	
Success stories	Farmers who adopt manure management practice have reported improved soil health and increased crop yield, and sustainable source of income
Application guidelines for users	<ul style="list-style-type: none"> The guidelines focus on the following areas:- Start by conducting a soil test to determine the recommendations regime for manures and mineral fertilizers Animal feeds-animals fed on high quality diets e.g high protein concentrates produce manures with high nitrogen content Livestock housing and manure management: proper manure handling results in high nutrient concentrations. Timing of application for maximum utilization by the crop Regular analysis of manure to ascertain the quality-
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Requires validation
G: Contacts	
Contacts	Director Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO, S. Kimani, E. Mutuma, D. Kamau, M. Okoti, J. Wamungo, A. Esilaba, F Wandera, E. Gikonyo
Partner organizations	County government, Private Public Partnerships

Research Gaps

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

2.5.3 TIMP name	Rapid soil testing services
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem addressed	Conventional methods for soil testing are not affordable to 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, SIDA 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension officers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Farmer visits • Training in workshops • Publicity campaigns done at county levels.
Critical/essential factors for successful promotion.	<ul style="list-style-type: none"> • Availability of the necessary equipment for rapid spot-on soil testing. • Established rapport between farmers and the technical personnel involved in soil testing. • Adequate qualified staff to cover the large number of samples from the target 24 counties before the planting season begins. • A well designed storage system for keeping information obtained at farm level including (GPS readings, physical description of the locations, raw measured scanned data, fertilizer recommendation according to crop type suitability). Availability a van to mount the equipment is equally necessary. • Farmers must understand, trust, and be willing to act upon the information provided
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • County government extension services; providing the link to farmers given that agriculture is devolved. • SoilCares; Provides soil scanners technology and capacity building in collaboration with KALRO and ICRAF, • ICRAF and SIDA tests and validates the recommendation

	<p>obtained in collaboration with SoilCares and KALRO.</p> <ul style="list-style-type: none"> • Fertilizer companies; To provide fertilizer blends according to soil health status • Agro dealers to stock required fertilizers that is readily available to farmers
C: Current situation and future scaling up	
Counties where already promoted	Technology has not been promoted though testing has been ongoing in a few counties
Counties where TIMP will be up scaled	All the 24 KCSAP counties
Challenges in dissemination	<ul style="list-style-type: none"> • It requires continuous updating methods to improve recommendations. • Lack of awareness on the importance of regular testing of soil quality
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness creation, intensive farmer field training (capacity building) • Make the whole process cost efficient. Use of scanners (spectroscopy) and less wet chemistry analysis. • Automated pipelines for updating existing recommendation methods.
Lessons learned in upscaling if any	Timely and affordable soil information will guide dry bean on fertilizer use. Farmers have reported frustration when they apply the fertilizers and record low yields because they did not take the first step to understand what the soil demand in terms of macro, micro nutrients and trace elements like Zinc and Sulphur.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • Socially acceptable since it brings income, increases food production, nutrition security and family cohesion. • Environmentally friendly because farmers only apply the required amounts of fertilizers. No excess nutrients to contaminate ground and surface water. • Increased productivity will increase dry bean supply to the markets to meet the rising demand. • Supporting frameworks/policies are available.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Soil testing equipment and License, sampling and packaging materials (Kes 650,000/=), personnel and logistics (will depend on site/location). • Shipping selected soil and plant materials for further testing and results verification in a certified lab. <p>here are other additional costs on professional consultation.S</p>
Estimated returns	Dependent on the enterprise adopting the service, but estimated at least 30% of current returns thus making agriculture a sustainable source of livelihood for entrepreneurs doing soil testing.
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Women have less access to credit to pay for the rapid soil testing services than men. • Women have less access to agricultural information, technology and

	<p>knowledge than men.</p> <ul style="list-style-type: none"> • Bringing services closer to the users saves time and resources to the various gender categories using the rapid soil testing.
Gender related opportunities	<ul style="list-style-type: none"> • Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in rapid soil testing.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge than men.
VMG related opportunities	<ul style="list-style-type: none"> • Offers employment opportunity especially for the youths who can be trained on soil sampling to help the local community in rapid soil testing.
E: Case studies/profiles of success stories	
Success stories	<p>Has been tested and successfully applied by other organizations like ICRAF, SoilCares & 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"> • A handheld scanner to testing soils and crops in the field • Community soil sampling champions are identified and trained on good soil sampling procedures. • Soil and crop are analyzed and the results including fertilizer recommendation generated on site.
F: Status of TIMP readiness (1=Ready for upscaling; 2=Requires validation; 3=Requires further research)	Requires Validation
G: Contacts	
Contacts	Director, Environment & Natural Resources, KALRO secretariat
Lead organization and scientists	KALRO; D. Kamau, C. Kibunja, A. Sila, , A. Esilaba, E Gikonyo, S. Kimani and F.Wandera
Partner organizations	County governments in the 24 counties, SoilCares, ICRAF and SIDA



2.5.4 TIMP Name	Bean Fertilizer Recommendation
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to limited use of fertilizer which contributes to food insecurity in Kenya.

<p>What is it? (TIMP description)</p>	<p>For better growth and high yield nutrition/fertilization is important particularly in the early stages of growth because it requires a lot of phosphorus minerals for root and shoot formation. The fertilizers can be classified as inorganic and organic fertilizer</p> <p>Inorganic fertilizer: Fertilizer that have plenty of phosphorus in their composition such as DSP, DAP, and SSP are recommended for beans. P is the major nutrients in these fertilizers. Crops that lack P, will be stunted with poorly developed roots which cause-reduced uptake of water and nutrients causing reduced N-fixation. Other elements, which enhance N-fixation, are Molybdenum Nitrogen, Ca and Mg; Zn and these will mostly be available in the blend fertilizers.</p>
<p>Justification</p>	<p>Most of the Kenyan soil are degraded and are low in organic matter resulting to low yield. Low/lack of use of fertilizers results to low productivity and reduced yield. Fertilizer application replaces the nutrients that are removed by the crops as they are harvested from the soils. Mineral fertilizers provide readily nutrients which are quickly absorbed by the beans</p> <div> </div> <p>A well fertilized beans Source: Catherine Muriithi</p>
<p>B: Assessment of dissemination and scaling up/out approaches</p>	
<p>Users of TIMP</p>	<p>Farmers in the region, agricultural extension workers, agrodealers</p>
<p>Approaches used in dissemination</p>	<p>Demonstrations and field days</p>
<p>Critical/essential factors for successful promotion</p>	<p>Conduct demonstrations and field days with farmers groups and stakeholders</p>
<p>Partners/stakeholders for scaling up and their respective roles.</p>	<p>County extension staffs, service providers, NGOs, Research organization (KALRO, CIAT)</p>
<p>C: Current situation and future scaling up</p>	
<p>Counties where already promoted. if any</p>	<p>Most Counties in Kenya uses fertilizer where beans are grown commercially eg Nyeri, Embu, Kirinyaga, Murang'a Nakuru</p>
<p>Counties where TIMPs will be upscaled</p>	<p>Laikipia and Nyeri</p>
<p>Challenges in development and dissemination</p>	<ul style="list-style-type: none"> • Poor management of available animal manure • Myth that beans do not require fertilizer

	<ul style="list-style-type: none"> • Small land holding limiting to large scale farming • High cost of fertilizer options
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Promotion of the low cost fertilization technologies • Training of regular practice of conservation agriculture(CA) in order to organic matter through mulch with minimum tillage options
Lessons learned in up scaling, if any	There are yield increase by over 100% where fertilization has been done
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social: Bean fertilizer recommendations will acceptable by farmers Environments!: Farmers need to debunk the myth that fertilizer use destroys the soil • Markets: Increased yields will be absorbed by the markets • Policy: Subsidized fertilizer through the Ministry of Agriculture will be available and affordable to enable mineral fertilizer use by most farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 3200 per 50kg bag while a cart(about 200kg) of organic animal manure will sell at 500ksh
Estimated returns	Not determined
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • Women have less access to credit to purchase the required inputs such as fertilizers • Women and youth have limited access to land for dry beans cultivation than men. • Women have less access to agricultural information, technology and knowledge on the required fertilizers than men.
Gender related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities such as the women and youth funds exists for women to access the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to credit to purchase the required inputs such as fertilizers • VMGs have less access to agricultural information, technology and knowledge on the recommended fertilizers than men.
VMG related opportunities	<ul style="list-style-type: none"> • Affirmative action opportunities such as the women and youth funds exists for women to access the required credit
E: Case studies/profiles of success stories	
Success stories	Through use of organic and inorganic fertilizers the yield in Nyeri County a farmer yield increased from one 90kg bag to six from half acre (Lucy Kimbocha)
Application guidelines for users	The fertilizer type to apply will depend on the nutrient status and the pH of the soil after doing soil analysis to get proper recommendation. Where soil are acidic blend fertilizer are recommended such as Baraka, Mavuno (10:26:10+Ca, Mg, S, Zn, Cu, Mn, Bo, and Mo) Agromaster (13:40:13) among others. The mineral fertilizer should be applied at a rate of 50kg/acre along the rows. The fertilizers are well mixed with soil before the seed is

	planted to avoid scorching. Organic fertilizer: Use of organic fertilizer is important where the soils are low in organic matter content. Well decomposed animal manure or compost is applied before shortly before the rains and mixed well with the soil. Recommended rate is 10 ton/ha
F: Status of TIMP Readiness	Ready for up scaling
G: Contacts	
Contacts	Center Director KALRO Embu, Katumani
Lead organization and scientists	KALRO Katumani;
Partner organizations	KALRO, Egerton University, Conservation Tillage Network

2.6 Soil and Water Management

2.6.1 TIMP name	Contour bunds
Category (i.e. technology, innovation or management practice)	TManagement Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to soil losses through water erosion and surface run off, loss of soil moisture through surface evaporation and frequent droughts. This leads to food insecurity.
What is it? (TIMP description)	<p>Contour bunds are stone or earthen walls built across a slope to prevent runoff.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Stone wall contour</p> </div> <div style="text-align: center;">  <p>Bunds constructed from earth walls</p> </div> </div> <p>Making furrows parallel to the contours ensures that rainfall and runoff are spread evenly over a field. The earthen bund is formed by excavating a channel and creating a small ridge on the downhill side. Thus contour bunds resemble narrow channel terraces commonly referred to as “fanyachini” terraces. The technology is highly suitable for areas with unpredictable rains especially the drought-prone areas (ASALs).</p>

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. The aim of contour bunds and hedgerows is to concentrate moisture into the ridge and furrow area where the crops are planted by trapping run off water from the catchment area between them. In Kenya, soil loss due to erosion is above the permissible limit of 2.2-10 t ha ⁻¹ yr ⁻¹ . Contour bunds decrease the risk of erosion. Plants with higher water requirements, such as peas or beans, can be planted on the higher side of the furrow whereas cereal crops requiring less water, such as dry beans, pigeon peas, sorghum or millet, can be planted on the ridges.a
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	Approaches to be used in the dissemination include: <ul style="list-style-type: none"> • On-farm demonstrations during farmer field schools
	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
C: Current situation and future scaling up	
Counties where already promoted if any	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	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"> • Increased risk of soil erosion if contours become defective • Labour intensive and many farmers may find it difficult to implement at large scale • Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Provide farmers support with appropriate equipment for contour construction for increased retention and output per man hour. • Training youthful farmers to be champions of contour bunds construction at the Ward level/village level. • Training on site specific designs and construction of contour bunds • Fast track land registration


Lessons learned, if any	<ul style="list-style-type: none"> • Contour bunds are popular due largely to the rapid benefits they give in terms of improved crop performance. • Existence of well-developed self-help groups can lead to successful soil and water conservation activities. • Conducting well publicized campaigns has been found to add to the success of soil and water conservation. • Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Social: Create awareness on the importance of soil and water conservation Avail low cost technologies for soil and water conservation</p> <p>Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level</p> <p>Policies: Policies that support individual land tenure systems C conservation P</p>
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for <i>contour</i> 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"> • It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women and youth have limited access to land for dry beans cultivation than men. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youths males exist in performing the technology.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The labour cost of adopting this technology might be out of reach for the VMGs thus affecting adoption and scaling up. • VMGs have limited access to land for dry beans cultivation than men. • VMGs have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMGs to implement in the field.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youth males exist in performing the technology.
E: Case studies/profiles of success stories	
Success stories, if any	Mukethe Mbithi is a member of the Kyungu Mwethya group in machakos "Before making the 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	Soil is excavated up-slope of the bund to a depth of 50 cm. Contourbunds should drain in one direction and can be manually or machine constructed. The length of a bund across a slope should be between 400to 500 m. The height of a bund should be at least 25 cm and have an approximate spacing of 1-2 m. In arid areas, the distance between bunds can be increased to 5-10 m. Hedgerows grown to stabilize bunds should be spaced at 4 to 8 m across the slope.
F: Status of TIMP readiness 1. Ready for upscaling, 2=Requires validation; 3=Requires further research	1 Ready for upscaling
G: Contacts	
Contacts	Institute Director KALRO Katumani P.O. Box 340-90100, MAchakos.E-mail: director.amri@kalro.org
Lead organization and scientists	KALRO: E. Njiru, A. Esilaba, A. Micheni, F.Wandera, S. Kimani and V. Wasike
Partner organizations	County governments' extension officers.

Research Gaps

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

2.6.2 TIMP name	Tied ridges
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields due to water stresses in production;

<p>What is it? (TIMP description)</p>  <p>Tied ridges almost filled with rain waer</p>	<p>Tied ridges are soil conservation structures comprising shallow furrows (about 50 cm wide and 30 cm deep) along each contour with a soil mound on the down-slope side of the furrow to create a ridge (about 20-30 cm high).</p> <p>Cross ties (ridges which are 15- 20 cm high) are created every 2-3 meters. Ties must be lower than the main ridges so that water never flows over the main ridges. The loss of water through evaporation is minimised by placing mulch in the furrows.</p>
<p>Justification</p>	<p>With limitations in soil moisture due to decreasing rainfall occasioned by climatic changes, tied ridges helps conserve soil moisture. In combination with furrow irrigation, the technology has potential to improve agricultural productivity and increase crop yields and cropping intensities. As a result, household food security, incomes and livelihoods are enhanced.</p>
<p>Region promoted</p>	<p>Tana River, Garissa, and West Pokot counties</p>
<p>B: Assessment of dissemination and scaling up/out approaches</p>	
<p>Users of TIMP</p>	<p>Farmers</p>
<p>Approaches used in dissemination</p>	<p>Demonstrations; Farmer field schools</p>
<p>Critical/essential factors for successful promotions</p>	<ul style="list-style-type: none"> • Proximity to water sources -close to permanent water sources • Suitable topography of area (level land) • Technical capacity for maintenance
<p>Partners/stakeholders for scaling up and their roles</p>	<ul style="list-style-type: none"> • County government – capacity building • Private sector – access to credit, capacity building • NGOs (Kenya Red Cross (KRC), Action Aid, World Vision, and OXFAM) – capacity building, credit facilities, facilitate technology access • National Irrigation Board – technology access and capacity building • Water Resources Management Authority – Water resources use management
<p>C: Current situation and future scaling up</p>	
<p>Counties where already promoted if any</p>	<p>Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru</p>
<p>Counties where TIMP will be promoted</p>	<p>Nyeri and Laikipia</p>
<p>Challenges in dissemination</p>	<ul style="list-style-type: none"> • Can be labour intensive during establishment phase • Poor management may lead to water use inefficiencies • Limited access to credit may limit uptake • Land tenure insecurity in some counties limits adoption and


	investments
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Enhancing farmers' capacity to see benefits • Enhance access to credit • Implement policy on land use and tenure
Lessons learned	<ul style="list-style-type: none"> • Use of tied ridges with furrow irrigation significantly increases yields • Poor management and designs may often result in flooding of low areas • Assessment of soil erosion and sediment is key to sustainability
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Socio-economic: The economics of making furrow and tying the ridges compared to return on investment Avail low cost equipment for making soil and water conservation structures,</p> <p>Environmental: Create awareness to accelerate implementation of soil and water conservation TIMPs at the County level</p> <p>Policies: Policies that support individual land tenure systems will accelerate investments in soil and water conservation</p>
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Not determined, but experiments have shown yield increases of 30% where tied ridges have been used.
Gender issues and concerns in development and dissemination	<ul style="list-style-type: none"> • It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. • Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youths in performing the task.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge than men. • The technology is labour intensive and may be difficult for the VMG to implement. • The cost of implementation for the TIMP can hinder the rapid adoption by the VMGs due to high poverty levels and financial challenges.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities for youths exist in performing the task.
E: Case studies/profiles of success stories	
Success stories	There are successful models for such technology i.e. Mwea and Perkerra irrigation schemes where furrow irrigation systems have provided opportunities for local community to produce high value crops. A sound understanding of the roles and responsibilities of farmers and water user associations is a feature of successful system.
Application guidelines for users	<p>Choose a site and clear the ground of rocks, bushes, grass and weeds.</p> <p>Mark out contour lines on the slope, at three meters apart.</p> <p>Dig a shallow furrow (about 50 cm wide and 30 cm deep) along each</p>

	<p>contour and put the soil on the down-slope side of the furrow to create a ridge (about 20-30 cm high).</p> <p>Create crossties (ridges which are 15- 20 cm high) every 3 meters. Ties must be lower than the main ridges so that water never flows over the ridges</p> <p>Use a rake or plank to level out each basin, as this is the water catchment area. Put mulch in the furrows if possible.</p> <p>Plant in two rows, one on either side of the ridge and furrow</p> <ul style="list-style-type: none"> • Denison, J.A., Smulders, H., Kruger, E., Ndingi, H. & Botha, M. (2011). Water Harvesting and Conservation: Volume 2: Part 1. Water Research Commission Report No. TT 492/11. • FAO Irrigation Water Management: Irrigation Manual • GoK MoALFI: Training Manual for Water Users Association and farmers. <ul style="list-style-type: none"> • Miriti, J.M., Esilaba A.O., Bationo, A., Cheruiyot, H., Kuhumba, J. and Thurania, E. (2007) Tied-ridging and integrated nutrient management options for sustainable crop production in semi-arid eastern Kenya <p>In book: Advances in Integrated Soil Fertility Management in sub-Saharan Africa: Challenges and opportunities</p>
F: Status of TIMPreadiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	1. Ready for upscaling
G: Contacts	
Contacts	Director
	Environment & Natural Resources KALRO Secretariat
Lead organization and scientists	KALRO: F. Wandera, A. Esilaba, E. Njiru, A. Micheni, V. Wasike, S. Kimani, J. Miriti and I. Sijali
Partner organizations	National Irrigation Board (NIB), Water Resources Management Authority


Gaps

1. The economic viability of the technology in different agro-ecological zones

2.6.3 TIMP name	Bench terraces
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low crop yields as a result of soil losses through water erosion and surface run off.
What is it? (TIMP)	Bench terraces consist of a series of beds which are more or less level

description)	<p>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.</p>  <p>Bench terraces in Mbooni, Makueni County,</p>
Justification	<p>Agricultural production is threatened in many parts of the Kenya by soil erosion and limited soil moisture. In Kenya, soil loss due to erosion is above the permissible limit of 2.2-10 t ha⁻¹yr⁻¹. Conservation of soil and moisture through construction of bench terraces has led to better and more reliable crop yields especially in the ASAL counties of Kenya.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers
Approaches to be used in dissemination	<p>Approaches to be used in the dissemination include:</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
C: Current situation and future scaling up	
Counties where already promoted if any reach	Makueni, Machakos, Tharaka Nithi, Kakamega, Nyeri, Meru
Counties where TIMP will be promoted	Nyeri and Laikipia
Challenge(s) in development and	<ul style="list-style-type: none"> • Increased risk of soil erosion if terraces are improperly laid out • Labour intensive during construction and maintenance and many



dissemination	<p>farmers may find it difficult to implement at large scale</p> <ul style="list-style-type: none"> Land tenure systems – communal land ownership, or in places where individuals don't have land title deeds
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Farmers need to be supported with appropriate equipment for preparation of Bench terrace for efficiency and increased output per man hour. Training youthful farmers to be champions of making bench terraces construction at the Ward level/village level. Training on site specific designs and construction of bench terraces Fast track land registration
Lessons learned, if any	<ul style="list-style-type: none"> Terracing is popular due largely to the rapid benefits it gives in terms of improved crop performance. Existence of well-developed self-help groups can lead to successful soil and water conservation activities. Conducting well publicised campaigns has been found to add to the success of soil and water conservation. Similarly, when the farmers are adequately trained and sensitized on the technology, many of them would be willing to invest.
Social, environmental, policy and market conditions necessary for development and upscaling	<p>Social: Create awareness on the importance of soil and water conservation Avail low cost equipment for making soil and water conservation structures,</p> <p>Environmental: Create awareness to accelerate implementation of soil and water conservation at the County level</p> <p>olicies: Policies that support individual land tenure systems will accelerate investments in soil and water conservationP</p>
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The main input cost is the labour for <i>Bench terrace</i> preparation. The cost will depend on the land size, labor costs 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"> It is labour intensive in terms of preparation and application hence may not be adopted by women who are already overburdened. Women have less access to agricultural information, technology and knowledge than men.
Gender related opportunities	<ul style="list-style-type: none"> Opportunities for youths males employment exist in performing the task of bench terraces.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to agricultural information, technology and knowledge than men. The technology is labour intensive and may be difficult for the VMG to implement in the field.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities for youths males employment exist in the task of bench terraces.
E: Case studies/profiles of success stories	
Success stories, if any	Mukethe Mbithi is a member of the Kyungu Mwethya group in machakos "Before making the bench terraces we didn't have good harvests because the soil was eroded. When we put fertilizer on, the water washed 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 run across the farm. Where farm sizes allow, the length should be 100 m or more. This 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%.c</p>
F: Status of TIMP readiness 1. Ready for upscaling, 2=Requires validation; 3=Requires further Research	<p>1 Ready for upscaling</p> 
G: Contacts	
Contacts	Institute Director KALRO Katumani P.O. Box 340-90100, MACHAKOS. E-mail: director.amri@kalro.org
Lead organization and scientists	KALRO: E. Njiru, A. Esilaba, A. Micheni, F. Wandera, S. Kimani, C. Kundu and V. Wasike
Partner organizations	County governments' extension offices.

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

2.7 Dry bean Crop Health

<p>2.7.1 TIMP name</p>	<p>Integrated management of bean stem maggots (<i>Ophiomyia phaseoli</i>) in dry beans</p>  <p>Bean fly maggots: (<i>Ophiomyia phaseoli</i>) Source: Plantwise.org.</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p>A: Description of the technology, innovation or management practice</p>	
<p>Problem addressed</p>	<p>Yield loss of 50-100% and low grain quality due to bean fly maggot Damage</p>
<p>What is it? (TIMP description)</p>	 <p>Integrated pest management (IPM) of bean stem maggot involves the combination of cultural, biological and chemical control methods. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Monitor and scout bean plants twice weekly by looking out for pale oviposition, larvae tunneling on leaves and swelling, cracking and presence of pupae/adults on stem. • Plant early in the season • Apply mulch and fertilizer for proper growth of the plant • Intercrop the beans with non-leguminous crop i.e. cereals • Avoid planting the dry beans near other leguminous host crops to break the life cycle of the pest • Remove weeds and volunteer plants around and within the dry bean plantation • Remove and destroy crop residues and all plant parts with symptoms of damage by bean flies by burying • Earth/ridge up the soil around the plants to cover the roots at 2-3

	<p>weeks after emergence</p> <ul style="list-style-type: none"> • Use resistant varieties i.e. Tasha, Chelalang and Ciankui <p>Biological control</p> <ul style="list-style-type: none"> • Use sticky pheromone traps at the rates of 24 pcs/acre to catch the adult flies from Koppert Kenya • Use of <i>Bacillus thuringiensis</i> (e.g Biokil WP, Bio-T-plus and BN3) at the recommended rates to control outbreaks. This can be purchased from Kenya Biologics. <p>Chemical control</p> <ul style="list-style-type: none"> • Spray of chemical products containing imidacloprid i.e. shambaza (10-20g/20L), Dominion 2L into the soil simultaneously with sowing of the crop or immediately after germination. Seedlings are treated about 3-4 days after emergence and, if bean fly infestations are severe, repeated at 7 days, and possibly at 14 days.
Justification	<p>Bean stem maggot 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 up to 100% are experienced due to the pest under high infestation levels reducing the quality and market value of the bean produce, posing challenges and fetches low prices or is rejected. Currently dry bean 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 chemical methods 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMPs	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers</p>
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products


successful promotion	<ul style="list-style-type: none"> • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on bean stem maggot • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage nematodes • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of bean stem maggots • Establishment of FFBS • Mapping of bean stem maggot free zones for up and out scaling of certified bean seed production funding by government to promote production and distribution of certified seeds at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture, Livestock, Fisheries & Irrigation (MoALF & I) Extension and Capacity Building • ICIPE (International Centre for Insect Physiology and Ecology)– collaborative research on crop protection • FAO (Food and Agricultural Organization)- co-sharing of resources and networking and knowledge management • CIGs (Common Interest Groups)- back stopping the technologies at grass root levels • NGOs (Non-governmental organization)(CARE Kenya): (Farmer Input Promotion) • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect pest management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang’a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Big challenge between information availability and accessibility • Non-exposure of the end-user to bean stem maggot and its management strategies • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – bean stem maggot integrated management strategies • Scaling up participation of end-user in on-farm activities/adaptive

	<p>research/extension activities</p> <ul style="list-style-type: none"> • Find innovations in reducing integrated management practices costs to encourage more bean production. • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Dissemination of integrated pest management practices and safe use of pesticides
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and adoption • Sensitization is necessary for people to appreciate the use of IPM in bean stem maggot management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the bean stem maggot management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 3000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 3,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10, 000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000. One off cost)
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 50-100% of KES 84,000 (ie a loss of 42,000-84,000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on maggots
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop

	<ul style="list-style-type: none"> Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to buy the required inputs such as chemicals VMGs have limited access to training and extension services Due to their social status VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> Opportunities for unemployed exists in spraying the crop. Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> Higley, L. G., and Boethel, D. J. (Eds.). (1994). Handbook of soybean insect pests (Vol. 1). Entomological Society of America. Mwanauta, R. W., Mtei, K. M., and Ndakidemi, P. A. (2015). Potential of controlling common bean insect pests (bean stem maggot (<i>Ophiomyia phaseoli</i>), <i>Oothea</i> (<i>Oothea bennigseni</i>) and Aphids (<i>Aphis fabae</i>)) using agronomic, biological and botanical practices in field. <i>Agricultural Sciences</i>, 6(05), 489. Abate, T., & Ampofo, J. K. O. (1996). Insect pests of beans in Africa: their ecology and management. <i>Annual review of entomology</i>, 41(1), 45-73. Plantwise Knowledge Bank. Infonet biovision. Plantix. Business Queensland and in a recent review by Nkhata et al. (2018).
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation
G: Contacts	
Contacts	<p>The Center Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: cd.katumani@kalro.org Phone: 0736333294</p> <p>Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org.</p>
Lead organization and scientists	KALRO-Katumani; Daniel Mutisya, David Karanja. KALRO Muguga South: Ochieng Berrick KALRO Kabete: Ruth Amata
Partner organizations	CABI, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

Research Gap

1. Explore Bio-control option for bean fly maggot

2.7.2 TIMP name	Integrated management of cutworms(<i>Agrotis spp</i>) in dry beans
	 <p>Cutworms: <i>Agrotis spp</i> Photo: agrilife.org</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of 30-40% attributed to Bean cutworm
What is it? (TIMP description)	<p>Integrated management (IPM) of bean cutworms involves the use of a combination of cultural, biological and chemical control methods. These include;</p> <p>Cultural Control</p> <ul style="list-style-type: none"> • Plough the land to expose caterpillars to predators and to desiccation by the sun. • Prepare field and destroy vegetation and weeds 10 to 14 days before planting the crop in the field. • Hand pick caterpillars at night or very early morning before they return into the soil at the beginning of the infestation. • Flood the field for a few days before sowing to kill cutworm caterpillars in the soil. • Bait traps consisting of flour and water and containing Bt, or other insecticides e.g. pyrethrum based ones • Use pheromone traps, ash and sticky substances i.e. molasses <p>Biological Control</p> <ul style="list-style-type: none"> • Spray neem-based products like Achook, Neemroc EC and Nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water). • Apply pesticides judiciously to conserve pteromalid wasps (parasitize the larvae), phytoseiid mites (feed on eggs), spiders (feed on adults) <p>Chemical Control</p>

	<ul style="list-style-type: none"> • Spray with Alpha Cypermethrin (Tata Alpha 10 EC-5ml/20 litres water, or Lambda-cyhalothrin products (Dududuthrin, Rate-60ml/20L)
Justification	<p>Cutworms cause considerable reduction in yield. Losses of above 30% are experienced due to the high pest infestation thus causing food security threat. Integrated Management of pests considering food safety concerns should be advocated considering that dry beans are the most consumed legume in Kenya. The IPM strategies involve the use of a combination of cultural, bio-control and biopesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers</p>
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on bean cutworm • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage nematodes • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of bean stem maggots • Establishment of FFBS Mapping of bean cutworm free zones for up and out scaling of certified bean seed production funding by government to promote production and distribution of certified seeds at


	farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang'a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting bean and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality

	<ul style="list-style-type: none"> Producers willing to adopt the insect management practices Producers are organized in groups to ensure that management practices are effectively up-scaled Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs)	
Considerations	
Basic costs	<ul style="list-style-type: none"> KES 3,000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 3,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10,000
Estimated returns	<p>Estimated returns 840kg/acre x KES100= KES 84,000</p> <p>Farmers who do not use the IDM package lose 30-40% of KES 84,000 (ie a loss of 25,200-33,600) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men Women have limited access to pest education, training and extension services than men Women have less access to agricultural information, technology and knowledge on cut worms
Gender related opportunities	<ul style="list-style-type: none"> Opportunities for youths exists in spraying the crop Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to buy the required inputs such as chemicals VMGs have limited access to training and extension services Due to their social status VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> Opportunities for unemployed exists in spraying the crop. Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> Infonet.biovision.org R.F. Long, UC Cooperative Extension Yolo County. P.B. Goodell (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier. Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates L.D. Godfrey, Entomology, UC Davis.
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires	<p>1-Ready for upscaling</p> <p>2-requires validation</p>

furtherresearch)	
G: Contacts	
Contacts	The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: cd.katumani@kalro.org Phone: 0736333294 Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org .
Lead organization and scientists	KALRO-Katumani, Daniel Mutisya, David Karanja.
Partner organizations	MoALF, CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore Bio-control option for cutworms.

2.7.3 TIMP name	Integrated management of Aphids (<i>Aphis fabae</i>) in Dry Beans
	 <p>Aphids: <i>Aphis fabae</i> Photo: greenlife.co.ke</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of 37-90% attributed to bean aphids
What is it? (TIMP description)	Integrated management of bean aphids involves selection of effective environmentally safe options such as; Cultural control <ul style="list-style-type: none"> • Intercrop beans with repellent crops such as onions and garlic • Weed the field to get rid of alternate host for aphids • Remove severely affected plants and destroy by burning • Use overhead irrigation to wash off aphids from the bean canopy • Use blue sticky traps at the rate of 8 traps per acre

	<p>Bio control</p> <ul style="list-style-type: none"> • Spray with neem oil 150ml/20 lts water and 100ml liquid soap/ water, Nimbecidine, Achook or Neemraj Super according to manufacturers' recommendation • Spray with <i>Beauveria bassiana</i> based product such as Beauvitech WP at rate 10g/20lts water and repeat sprays after 14 days <p>Chemical control</p> <ul style="list-style-type: none"> • Spray Acetamiprid like Aceta 20SP. Acetak Top 70 WG (5-10ml/20lts) or lambda cyhalothrin products such as Pentagon (10-15 ml/20 lts) or Deltamethrin based products such as Atom, Decis at the rate of 10-15mls/20 lts of water.
Justification	<p>Bean aphid species have increased across the country preventing potential yield of beans in most areas and causing up to 90% yield loss. The use of cultural practices, different insecticide molecules and biological products have helped in minimizing resurgence of aphid populations in farms. IPM will ensure aphid populations are kept below economic injury levels. Like most other pests. Aphids have natural enemies such as lady beetle larva, wasps, spiders and parasitic fungi that are protected through use of IPM. Therefore, improving diversity, by planting wild flower strips in the bean fields and hedge rows, will enhance the population beneficial insects.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's, Seed producing companies and SMEs, Processors, Agro-input dealers</p>
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer field and business schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on aphids • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices

	<ul style="list-style-type: none"> • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage aphids • A strong partnership between technical personnel /Extension / companies producing biological control and bio pesticides products and farmers would enhance promotion. • Capacity building of farmers, extension officers and other stakeholder on integrated management practices of aphids • Establishment of FFBS funding by government to promote production and distribution of certified seed at farm level
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Ministry of Agriculture, Livestock, Fisheries & Irrigation (MoALF & I) Extension and Capacity Building • ICIPE (International Centre for Insect Physiology and Ecology)– collaborative research on crop protection • FAO (Food and Agricultural Organization)- co-sharing of resources and networking and knowledge management • CIGs (Common Interest Groups)- back stopping the technologies at grass root levels • NGOs (Non-governmental organization) (CARE Kenya): (Farmer Input Promotion) • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in aphid management • PCPB to promote registration of pesticides for aphid management • Universities to develop the technologies and conduct ToTs. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang'a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Big challenge between information availability and accessibility • Non-exposure of the end-user to aphids and its management strategies • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Information dissemination – aphid integrated management strategies • Scaling up participation of end-user in on-farm activities/adaptive research/extension activities • Find innovations in reducing integrated management practices costs to encourage more beans production. • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Dissemination of integrated pest management practices and safe use of pesticides
Lessons learned in up scaling,	<ul style="list-style-type: none"> • Adoption of FFBS effective in technology dissemination and


if any	<p>adoption</p> <ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in aphid management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the aphid management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs)	
Considerations	
Basic costs	<ul style="list-style-type: none"> • KES 3,000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 3,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10,000
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 37-90% of KES 84,000 (ie a loss of 31,080-75,600) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on aphids.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness

VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • <u>R.F. Long</u>, UC Cooperative Extension Yolo County • <u>P.B. Goodell</u> (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier • Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates L.D. Godfrey, Entomology, UC Davis. • Plantwise Knowledge Bank. • Infonet biovision
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires furtherresearch)	1-Ready for upscaling
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Katumani P.O. Box 340-90100, MachakosEmail: cd.katumani@kalro.org Phone: 0736333294</p> <p>Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO-Katumani; Daniel Mutisya, David Karanja. KALRO Muguga South: Ochieng Berrick KALRO Kabete: Ruth Amata
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

Research Gaps:

1. Explore ways for natural promotion of biological control of aphids.

2.7.4 TIMP name	Integrated management of Blister beetle (<i>Mylabris spp</i>) in bean flowers.
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		<p>Blister beetle: <i>Mylabris spp</i> Source : plantwise.org</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>	
<p>A: Description of the technology, innovation or management practice</p>		
<p>Problem addressed</p>	<p>Yield losses of up to 63% attributed to Blister beetle</p>	
<p>What is it? (TIMP description)</p>	<p>Integrated pest management (IPM) of Blister beetle involves the combination of cultural, biological and chemical control methods. These are:</p> <p>Cultural Control</p> <ul style="list-style-type: none"> • Scout your farm 2-3 times a week and look out for soft bodied bright and variegated, striped or flat insects on the plants and hand pick the insects as soon as you see them • Practice clean weeding around and within the farm to remove alternative host of blister beetles • Encourage birds to come to your farm by providing feeds Do not use chemical sprays or that harm them. <p>Biological Control</p> <ul style="list-style-type: none"> • Use Semaspore Bait which contains Nosema locustae, to control grass hoppers which attract blister beetles whose larvae feed on the grasshopper's eggs from Koppert Kenya. • Spray hopper bands using <i>Metarhizium anisopliae</i> based products like Mazao achieve (rate 2l/ ha), Biomagic 1.5 LF (rate 20g/ 20lts water), Real Metarhizium OD (rate 200ml/ ha) among others. Spray at intervals of 3 - 14 days depending on risk of pest damage <p>Chemical Control</p> <ul style="list-style-type: none"> • Spray pyrethroid insecticides, such as Pesthrin 6% EC, rate, lambda-cyhalothrin (e.g Duduthrin 1.75EC, Halothrin 2.5EC), and alpha-cypermethrin (e.g Alphacypermethrin, Albaz, Alfatox 10EC) according to manufacturer's recommendations. 	
<p>Justification</p>	<p>Blister beetle is a serious pest of dry beans causing yield losses of above 60% in many bean growing areas of the country. Flowers of infested plants wilt and die at very early stage. If uncontrolled, the pest can wipe out a whole bean field resulting into a total crop failure. It is therefore advisable to use integrated management approach since it is cost effective, gender</p>	


	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.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and bio pesticides products and farmers would enhance promotion
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities

C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang'a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting beans and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish beans innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs)	
Considerations	
Basic costs	<ul style="list-style-type: none"> • KES 3,000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 1,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 8,000
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 63% of KES 84,000 (ie a

	loss of 52,920) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on blister beetle
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • Gahukar, R. T., and Reddy, G. V. (2018). Management of insect pests in the production and storage of minor pulses. <i>Annals of the Entomological Society of America</i>, 111(4), 172-183. • Plantwise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires furtherresearch)	1- Ready for upscaling
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: cd.katamani@kalro.org Phone: 0736333294</p> <p>Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO Katumani, Daniel Mutisya, David Karanja.
Partner organizations	ICIPE, KEPHIS, Real IPM, Koppert, Universities, County government, CIGs, Bayer Crop science

Research Gaps:

1. Explore ways for natural promotion of biological control of flower beetles.

<p>2.7.5 TIMP name</p>	<p>Integrated management of African Bollworm(<i>Helicoverpa armigera</i>) in beans</p>
	 <p>African Bollworm(<i>Helicoverpa armigera</i>) Source: grdc.com.au</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p>A: Description of the technology, innovation or management practice</p>	
<p>Problem addressed</p>	<p>Yield losses of 36-60% Attributed to the African Bollworm.</p>
<p>What is it? (TIMP description)</p>	<p>Integrated pest management (IPM) of African Bollworm involves the combination of chemical, biological and cultural control methods. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Regularly scout for eggs and young caterpillars (larvae) with short hairs along their backs to control the pest early • Remove and destroy plant residues by burying immediately after harvesting. • Plough the soil after harvesting. This exposes pupae, which may then be killed by natural enemies or through desiccation by the sun • Handpick and destroy eggs and small caterpillars. This is feasible in small farms or when infestations are low. • If African bollworms are detected in the field, sort out the harvested crop very thoroughly and remove the caterpillars manually. • Intercrop bean field with trap crops i.e. cereal crops then later destroy the trap to control the outbreak of African bollworm. • Crop rotation with non-legume crops e.g onions, tomatoes, spinach etc • Avoid planting crops that are susceptible to bollworm after each other e.g like cotton, maize, sorghum, tobacco, soybean, and tomato to reduce/prevent build up of bollworm populations • Grow maize as a trap crop at 10 m interval to reduce pod damage in beans • Cover the crop using agronets to reduce pest infestation on the crop <p>Biological control</p> <ul style="list-style-type: none"> • Spray neem based products like neemroc EC, Neemraj Super and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water) to control the pest and help conserve egg parasitoids (e.g. Trichogramma spp.), larval parasitoids (wasps and flies that parasitise

	<p>caterpillars), and predators such as ants, assassin bugs, minute pirate (anthocorid) bugs, lacewings and ladybird beetles.</p> <ul style="list-style-type: none"> • Use of <i>Bacillus thuringiensis</i> e.g Biokil, Bio-T-Plus, or BN3 at the recommended rates to control outbreaks. This can be purchased from Kenya Biologics • Use sticky pheromone traps at the rates of 24 pcs/acre to catch the adult flies from Koppert Kenya <p>Chemical control</p> <ul style="list-style-type: none"> • Spray Deltamethrin 5g/L e.g. Decis 0.5 ULV 10-15 ml in 20 liters of water OR Atom 2.5 EC at rate of 10-15 mls in 20 liters of water • Spray Bifenthrin 25g/L e.g. Biferan 25EC OR Seizer 80 SC at a rate of 20ml in 20 liters of water
Justification	Where the pest is severe and not controlled, 100% yield losses are experienced due to the pest. Currently bean farmers use a lot of synthetic pesticides in their control. Integrated Management of pests considering food safety concerns should be highly advocated due to food and environmental safety. This involves the use of a combination of cultural and bio-control and bio pesticides that are relatively safe. Soft synthetic pesticides are recommended as a last option.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects

	<ul style="list-style-type: none"> • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang'a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting beans and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to


	<p>farmers are genuine and of high quality</p> <ul style="list-style-type: none"> • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs)	
Considerations	
Basic costs	KES 4,000 as costs for insecticides and application per acre per season; KES 5000 per acre for insect traps. KES 6,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 15,000
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 36-60% of KES 84,000 (ie a loss of 30,240-50,400) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on African bollworm
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • Seif, A. A, Varela, A. M., Michalik S. and Lohr B. (2001): A Guide to IPM in French Beans Production with Emphasis on Kenya. ISBN: 92 9064 142 8. • Sithanatham, S., Baumgartner, J. and Matoka, C. (2002). Ecosystem Approach for Management of <i>Helicoverpa armigera</i> in Eastern Africa. In African Bollworm Management in Ethiopia. Status and needs. Proceedings of the National Workshop held at the Plant Protection Research Centre Ambo, Ethiopia. April 2002. pp 129-134.

	<ul style="list-style-type: none"> • Stoll, G. (1986). Natural Crop Protection in the Tropics. AGRECOL. ISBN: 3-8236-1113-5. van den Berg, H. (1993). Natural control of <i>Helicoverpa armigera</i> in smallholder crops in East Africa. Thesis Wageningen. ISBN: 90-5485-107-4 • Varela, A. M., Seif, A. A. and Lohr B. (2003). A Guide to IPM in Tomato Production in Eastern and Southern Africa. ISBN: 92 9064 149 5. • Varela, A. M., and Seif, A. A. (2004). A Guide to IPM and Hygiene Standards in Okra Production in Kenya. ISBN: 92 9064 161 5. • Youdeowei, A. (2002). Integrated pest management practices for the production of vegetables. Ministry of Agriculture (MOFA) Plant Protection and Regulatory Services Directorate (PPRSD), Ghana, and the German Development Cooperation (GTZ). ISBN: 9988-0-1088-5. • Plant wise Knowledge Bank
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1- Ready for upscaling 2- requires validation
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Katumani P.O. Box 340-90100, Machakos Email: cd.katumani@kalro.org Phone: 0736333294</p> <p>Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p>
Lead organization and scientists	KALRO- Katumani, Daniel Mutisya, David Karanja.
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore ways for natural promotion of biopesticides within the agro ecosystem in control of African bollworm.

2.7.6. TIMP name	Integrated management of <i>Maruca pod borer (Maruca vitrata)</i> in beans
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	 <p>Maruca pod borer (<i>Maruca vitrata</i>) Source: plantwise.org</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of 20-80% attributed to the Maruca pod borer
What is it? (TIMP description)	<p>Integrated pest management (IPM) of Maruca pod borer involves the combination of cultural, biological and chemical control methods. IPM order of management control will be:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Scout for early signs of webbing of the flowers by the caterpillars, handpick them and destroy • Rotate dry bean with non-host crop (e.g cereals) and establishment of repellent/trap crops. • Integrate fertilizer and manure which promote plant vigor. • Intercrop dry beans with crops from cereal family i.e maize, sorghum • Remove and destroy crop debris by burying 2 feet deep after harvest • <p>Biological control</p> <ul style="list-style-type: none"> • Spray neem based products like Neemroc EC and Nimbecidine (Azadiractin) according to manufacturers recommendations to control the pest and help conserve egg parasitoids (e.g. Trichogramma spp.), larval parasitoids (wasps and flies that parasitise caterpillars), and predators such as ants, assassin bugs, minute pirate (anthocorid) bugs, lacewings and ladybird beetles. • Use of <i>Bacillus thuringiensis</i> products (e.g Biokil, BN3 5WP, Bio-T-Plus) at the recommended rates to control outbreaks. This can be purchased from Kenya Biologics • Use sticky pheromone traps at the rates of 24 pcs/acre to catch the adult flies from Koppert Kenya <p>Chemical control</p> <ul style="list-style-type: none"> • Spray Deltamethrin 5g/L e.g. Decis 0.5 ULV 10-15 ml in 20 liters of water OR Atom 2.5 EC at rate of 10-15 mls in 20 liters of water • Spray Bifenthrin 25g/L e.g. Biferan 25EC OR Seizer 80 SC at a rate of 20ml in 20 liters of water
Justification	Maruca pod borer causes flower abortion and pod damage in beans thus compromising the quality of the crop. Where the pest is severe and not

	<p>controlled plants become greatly reduced in size and yield. Losses of above 80% 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 bean farmers use a lot of synthetic pesticides in their control. Integrated Management of pests which considers food safety concerns should be highly advocated considering that beans are 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology


	<ul style="list-style-type: none"> • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favor the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang'a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting bean and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) Considerations	

Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per season; KES 5000 per acre for insect traps. KES 3,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 12,000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 20-80% of KES 84,000 (ie a loss of 16,800-67,200) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge for instance they might not have knowledge of integrated management of Maruca pod borer
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • Bean podborer (2018) Business Queensland. Queensland Government. (https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/crop-growing/pests-field-crops/bean-podborer) • CABI (2020) Maruca vitrata (lime bean pod borer). Crop Protection Compendium. (https://www.cabi.org/cpc/datasheet/32566).
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-required)	1- Ready for upscaling 2- requires validation
G: Contacts	
Contacts	The Centre Director, KALRO Katumani P.O. Box 340-90100, Machakos Email: cd.katumani@kalro.org

	Phone: 0736333294 Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org
Lead organization and scientists	KALRO- Katumani, Daniel Mutisya, David Karanja.
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore ways for natural promotion of biological control of bean pod borer

2.7.7. TIMP name	Integrated management of Thrips (<i>Megalurothrips sjostedti</i>) in beans  Thrips (<i>Megalurothrips sjostedti</i>) Source: infonet.biovision.org .
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield losses of 13-64% attributed to thrips
What is it? (TIMP description)	Integrated management (IPM) of thrips involves the use of a combination of cultural, biological and chemical control methods. These are; Cultural Control <ul style="list-style-type: none"> • Maintain a healthy crop as it tolerates thrips • Avoid planting new crop near an existing infected field • Mulch fields as this helps reduce thrips population • Use overhead irrigation where possible to reduce spread of thrips • Remove and destroy volunteer plants and debris that may harbour thrips by burying 2 ft deep • Uproot heavily infested plant material and bury • Apply soapy sprays (mix 5 teaspoon full of soap powder or chopped bar soap with cold water and dissolve and spray on the infested

	<p>plants</p> <ul style="list-style-type: none"> • Use blue sticky cardboard traps to attract thrips. <p>Biological control</p> <ul style="list-style-type: none"> • Apply biocontrol agents e.g Beauvitech WP (<i>Beauveria bassiana</i>) or Bio-Power 1.5L (<i>Beauveria bassiana</i>), or Botanigard ES (Azadirachtin), • Spray neem-based products like Neemroc EC and Nimbecidine (Azadirachtin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water). <p>Chemical Control</p> <ul style="list-style-type: none"> • 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 • Use synthetic insecticides with PHI of 3 days or less since bean is harvesting at very short intervals.
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 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 bean 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 beans are 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches used to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS)


	<ul style="list-style-type: none"> • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	All other Counties with suitable agro-ecological settings for bean production
Counties where TIMPs will be upscaled	Nyeri, Machakos, Murang'a, Narok and Kakamega.
Challenges in dissemination	<ul style="list-style-type: none"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting beans and losses attributed to them • Poor linkages among stakeholders in bean value chain

Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish beans innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per season; KES 3000 per acre for insect traps. KES 3,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10,000 • (Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000)
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 13-64% of KES 84,000 (ie a loss of 10,920-53,760) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to bean thrips management education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the

	required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • 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. • Infonet.biovision.org
F: Status of TIMP readiness	
(1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling 2-requires validation
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Katumani P.O. Box 340-90100, MachakosEmail: cd.katumani@kalro.org Phone: 0736333294</p> <p>Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org</p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: info.ptc@kalro.org; Telephone: +254-0727615868</p>
Lead organization and scientists	KALRO- Katumani, Daniel Mutisya, David Karanja.
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore ways for natural promotion of biological agents to suppress Thrips on dry bean.

<p>2.7.8. TIMP name</p>	<p>Integrated Management for bean Army worm (<i>Spodoptera exigua</i>) in beans</p>
	 <p>Bean army worm (<i>Spodoptera exigua</i>) Source: C. Scott, UF</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p>: Description of the technology, innovation or management practice</p>	
<p>Problem addressed</p>	<p>Yield loss of up to 92% attributed to the army worm</p>
<p>What is it? (TIMP description)</p>	<p>Integrated management (IPM) of bean army worm involves the use of a combination of cultural, biological and chemical control methods. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Scout at least twice per week for presence of army worms, late evening or early morning as they actively feed on the plant. • Hand-pick the caterpillars whenever they occur on the farm • Field sanitation through regular weeding on the farm • Plough the field thoroughly. Turning the soil exposes armyworm pupae to desiccation and natural enemies. • Plant resistant/tolerant bean varieties to bean army worm • Avoid burning and overgrazing of grasslands, which are the natural habitat and food store of the caterpillars. Burning often causes outbreaks because as soon as temperatures rise, eggs are laid in large quantities on the fresh new grass. • Use pitfall traps, light traps on the farm <p>Biological control</p> <ul style="list-style-type: none"> • Apply biocontrol agents e.g. Beauvitech WP (<i>Beauveria bassiana</i>) or Bio-Power 1.5L (<i>Beauveria bassiana</i>), or Botanigard ES (Azadirachtin), the biopesticides should be applied late in the evening when the caterpillars are actively feeding. • Spray neem based products like Neemroc EC and Nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water), which is environmentally friendly to Lacewings, predatory wasps,

	<p>parasitic wasps, flies, and spiders that attack armyworm caterpillars.</p> <ul style="list-style-type: none"> • Use of sticky pheromone traps at the rate of 24 pcs/acre to control the adult African army worm
Justification	<p>Army worms cause considerable reduction in yield and lower the quality of beans. Where the pest is severe and not controlled plants become greatly reduced in yield by up to 100%. Marketing of such produce that is severely affected poses challenges and fetches low prices. Integrated Management of pests considering food safety concerns should be highly advocated considering that beans are very widely consumed in Kenya.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's</p>
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management


	<ul style="list-style-type: none"> • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMPs 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"> • Unwillingness of farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting bean and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per

	season; KES 3000 per acre for insect traps. KES 3,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10,000
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 92 % of KES 84,000 (ie a loss of 77, 280) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI. (2004). Crop Protection Compendium, 2004 Edition. (c) CAB International Publishing. Wallingford, UK. www.cabi.org. • DLCOEA Technical Bulletin (2002). Responses by farmers to African Armyworm Outbreaks: Field Survey Data from Kenya and Tanzania. A synopsis of previously unpublished data. Collated and edited by Malcolm Iles and Charles Dewhurst. University of Greenwich and NRI. ISBN: 0-85954-542-3 • HDRA. Henry Doubleday Research Association, UK. www.gardenorganic.org.uk. • Halting the march of African armyworm. New Agriculturist. Online. January 2006. www.new-agri.co.uk. • Hill, S. D. (1983). Agricultural insect pests of the tropics and their control. Second Edition. Cambridge University Press. ISBN: 0-521-24638-5. • IRRI. Armyworm. www.knowledgebank.irri.org.
F: Status of TIMP readiness	1-Ready for upscaling

(1-Ready for upscaling, 2-requires validation, 3-requires further research)	
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Email: cd.narl@kalro.org Phone: 0727624471 Centre Director KALRO Katumani</p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: info.ptc@kalro.org; Telephone: +254-0727615868</p> <p>The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075</p>
Lead organization and scientists	KALRO- Muguga/Kabete/Katumani. Berrick Ochieng, Ruth Amata., Daniel Mutisya., Karanja D.,
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Determine tolerance of new bean varieties to bean army worm in various AEZ's
Explore the use of ITKs in pest management

2.7.9 TIMP name	Integrated Management for corn earworm (<i>Helicoverpa zea</i>) in beans
	 <p>Corn earworm (<i>Helicoverpa zea</i>) Source: UC-IPM</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of over 50% attributed to corn ear worm
What is it? (TIMP	Integrated pest management (IPM) of African Bollworm involves the combination

description)	<p>of chemical, biological and cultural control methods. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Regularly look for eggs and young caterpillars (larvae with short hairs along their backs) for timely control • Remove and destroy plant residues by burying 2 ft deep immediately after harvesting. • Plough fields after harvesting. This exposes pupae, which may then be killed by natural enemies or through desiccation by the sun • Handpick and destroy eggs and small caterpillars. This is feasible in small plots or when infestations are low. • If African bollworms are detected in the field, sort out the harvested crop very thoroughly and remove the caterpillars manually. • Intercrop bean field with trap crops i.e. cereal crops then later destroying the trap crop to control the outbreak of corn earworm. • Crop rotation with non-legume crops i.e. crops e.g onion, maize, cabbage • Avoid planting crops after each other that are susceptible to bollworm like cotton, maize, sorghum, tobacco, soybean, and tomato to reduce/prevent build up of bollworm populations • Grow maize as a trap crop at 10 m interval to reduce pod damage in beans • Cover the crop using agronets to reduce pest infestation on the crop <p>Biological control</p> <ul style="list-style-type: none"> • Spray neem based products like neemroc EC and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water) to control the pest and help conserve egg parasitoids (e.g. Trichogramma spp.), larval parasitoids (wasps and flies that parasitise caterpillars), and predators such as ants, assassin bugs, minute pirate (anthocorid) bugs, lacewings and ladybird beetles. • Use of <i>Bacillus thuringiensis</i> (e.g Biokil, BN3 5WP, Bio-T-Plus) at recommended rates to control outbreaks. • Use sticky pheromone traps at the rates of 24 pcs/acre to catch the adult flies from Koppert Kenya <p>Chemical control</p> <ul style="list-style-type: none"> • Spray Deltamethrin 5g/L e.g. Decis 0.5 ULV 10-15 ml in 20 liters of water OR Atom 2.5 EC at rate of 10-15 mls in 20 liters of water • Spray Bifenthrin 25g/L e.g. Biferan 25EC OR Seizer 80 SC at a rate of 20ml in 20 liters of water
Justification	<p>Corn ear worm cause considerable reduction in yield of over 50% and lower the quality beans. Where the pest is severe and not controlled yield is greatly reduced, posing challenges and produce rejected. Integrated Management of pests considers food safety concerns & should be highly advocated considering that beans are very widely consumed in Kenya.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's

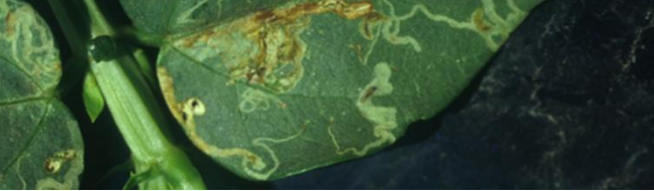
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMPs 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"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting bean and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCBPB, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 8,000 as costs for insecticides and application per acre per season; KES 3000 per acre for insect traps. KES 4,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 15,000 per season/acre
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 per season/per acre • Farmers who do not use the IDM package lose 50 % of KES 84,000 (ie a loss of 42, 000) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge

Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • <u>R.F. Long</u>, UC Cooperative Extension Yolo County • <u>P.B. Goodell</u> (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier • Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates L.D. Godfrey, Entomology, UC Davis
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1- Ready for upscaling
G: Contacts	
Contacts	<p>Centre Director KALRO Kabete, P.O. Box 14733 00800 NBI cd.narl@kalro.org. Phone: 0727624471</p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: info.ptc@kalro.org; Telephone: +254-0727615868</p>
Lead organization and scientists	KALRO-Muguga/Kabete/Katumani Ochieng Berrick., Ruth Amata., and David Karanja
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Determine performance of new bean varieties in new areas with respect to corn ear worm
2. Explore Bio-control option for corn ear worm
3. Explore the use of ITK's in insect pest management

2.7.10 TIMP name	Integrated Management of leaf miner(<i>Liriomyza trifolii</i>) in beans
	 <p>leaf miner(<i>Liriomyza trifolii</i>) Source: www2.ipm.ucanr.edu</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of between 50-80%.
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>Cultural Control</p> <ul style="list-style-type: none"> • Plant clean seedlings free from all stages of the moth. • Rotate with non-host crops such as maize, and cabbages. • Remove and destroy wild host plants such as sodom apple around the farm. • Remove and burn all infected crop residues. • Remove infested leaves before the caterpillar pupates inside and becomes an egg-laying adult. • Bury deep (50-100 cm) infested plants and foliage. • Use black sticky traps - 24 pcs/acre, placed 15-20 cm above the ground. <p>Bio-Control</p> <ul style="list-style-type: none"> • Use of <i>Bacillus thuringiensis</i> products e.g Biokil, BN3 %WP, Bio-TT-Plus to control outbreaks. • Pheromone traps (8 per acre). 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 • Use black sticky traps from Koppert Kenya <p>Chemical Control</p> <p>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.</p>
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

	<p>reduced in size and yield. Losses of above 80% 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 bean 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management


	<ul style="list-style-type: none"> • PCPB to promote registration of insecticides for insect management • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Muranga, Embu. Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMPs 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"> • Unwillingness of farmers to adopt IPM technologies • In adequate knowledge on IPM strategies on insect pests infesting bean and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per season; KES 2000 per acre for insect traps. KES 4,000 as labor and other costs

	for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10,000
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 per acre per season • Farmers who do not use the IDM package lose 50-80% of KES 84,000 (ie a loss of 42, 000-67,200) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on leaf miner
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • Pest Management Practices Prescribed by Frontline Extension Workers in the Smallholder Agricultural Subsector of Kenya.2018. Ochilo W N, Otipa M, Oronje M. Oxford University Press in Journal of Integrated Pest Management. 2018;9(1). doi:10.1093/jipm/pmy009.
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1- Ready for upscaling
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471</p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika:</p>

	Email: info.ptc@kalro.org ; Telephone: +254-0727615868
Lead organization and scientists	KALRO-Muguga/Kabete/ Katumani, Berrick Ochieng., Ruth Amata.,and David Karanja,
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore the effectiveness of bio-control options for managing leaf miner in different bean varieties
2. Explore the use of ITKs in pest management of the different bean varieties. Assess the tolerance of the bean varieties to Leaf miner in the various AEZ's

2.7.11 TIMP name	Integrated Management for Red spider mites (<i>Oligonychus gossypii</i>) of beans
	 <p>Red spider mites (<i>Oligonychus gossypii</i>) Source: bugsforbugs.com.au</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of between 40-60% attributed to Red spider mites
What is it? (TIMP description)	<p>Integrated management of Red spider mites consists of several approaches applied in an integrated manner to break the cycle of the insect. These include:</p> <p>Cultural Control</p> <ul style="list-style-type: none"> • Keep the farm weed free from alternative hosts such as solanaceae family • Avoid planting tomato next to infested field or crops. • When moving through the farm, start with the healthy area before moving to infected section. • Conserve natural enemies or release predatory <i>Phytoseilus</i> spp from Real IPM or Dudutech Ltd. • Use overhead irrigation as it helps in drowning the mites hence reducing their population • Prun overcrowded plants and destroy the crop debris by burning. <p>Bio-control control</p> <ul style="list-style-type: none"> • Spray with neem extracts (500 grams of leaves in 5 litres of water) or neem based products e.g Nimbecidine, Achook or Neemraj Super

	<ul style="list-style-type: none"> • Release predatory mites (Phytotech and Amblytech from dudutech) <i>Phytoseiulus persimilis</i> species and <i>Amblyseius cucumeris</i> • Conserve natural enemies in the environment or release purchased predatory <i>Phytoseiulus</i> species from Real IPM or Dudutech Ltd <p>Chemical Control</p> <ul style="list-style-type: none"> • Spray with abamectin 18g/kg based synthetic pesticides (Dynamec 20EC 5ml/20litres water, Knockbect 40EC, 10 ml/20 Litre water) or • Spray with Amitraz 200g/L based miticides (Kilitac 20EC, Mitac 20 EC. Rate 10ml/20Litre water)
Justification	Red spider mites are a major challenge in bean production with yield losses of over 60%, and it is attributed to farmers recycling seed from previous season's crop which carry insect pests and eggs. Presence of Integrated management options will provide farmers with a basket of safe management options contributing to a safer environment and better human health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for	<ul style="list-style-type: none"> • Extension agents (both private and public):


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

	<ul style="list-style-type: none"> • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 4,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 12,000
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x KES100= KES 84,000 • Farmers who do not use the IDM package lose 40-60% of KES 84,000 (ie a loss of 33,600-50,400) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on red spider mites
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • CABI-Plantwise Knowledge Bank • 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. • Infonet.biovision.org
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	Director - KALRO Seeds;

	<p>P.O. Box 6223 01000 Thika: Email: info.ptc@kalro.org; Telephone: +254-0727615868</p> <p>Centre Director KALRO Kabete, Box 14733-00800, NAIROBI. Tel: +254-020-2464435 Ext. 300 E-mail: cd.narl@kalro.org The Centre Director Food Crops Research Centre – Muguga South P. O. Box 30148-00100, Nairobi, Kenya. Email: fcrc.muguga@kalro.org Tel: +254-0722219075</p>
Lead organization and scientists	KALRO-Kabete/Seed/Muguga, Berrick Ochieng, Ruth Amata.,and David Karanja
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore Bio-control options for management of Red spider mites
2. Explore the use of ITKs in pest management
3. Farmer participatory evaluation of the management of bio-pesticide options for insect management

2.7.12 TIMP name	Integrated Management for stink bugs (<i>Nezara viridula</i>) in beans
	 <p>Stink bugs (<i>Nezara viridula</i>) Source: Bernard Spragg, Flickr.com</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of up to 58% attributed to stink bugs.
What is it? (TIMP description)	<p>Integrated Pest Management of Stink bug involves use of Cultural, Biological and Chemical practices. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Use of early maturing crop varieties as trap crops for control actions to reduce pest populations (e.g. cowpeas, beans,

	<p>crucierous plants). Plough trap crops in the soil to prevent adult pests from migrating to the main crop.</p> <ul style="list-style-type: none"> • Remove volunteer bean plants to reduce overwintering of insects • Employ suitable crop sanitation practices such as: actively removing dead plant parts and weeds from fields and buryin 2ft deep • Washing tools/machinery using Jik (50ml/Litre of water) • Intercrop with non-related crops such as maize or sorghum <p>Biological control</p> <ul style="list-style-type: none"> • Spray with botanical extracts e.g. neem seed extract (take 50 g mix in 2 L of water, boil for 15 minutes, allow to cool and spray 3 times at 2 week intervals). Spray with neem based products e.g Nimbecidine, Achook and Neemraj Super • Spray plants with soapy water to remove insects. Handpick any that are found and destroy. • Spray with <i>Beauveria bassiana</i> products and follow instructions on the label.
Justification	<p>Bean stink bugs have increased across the country preventing potential yield of beans, causing yield losses of over 60% to bean plant in most areas by puncturing holes in crops causing secondary fungal or bacterial infections. The use of different insecticide molecules and biological products have helped minimize resurgence of stink bugs populations in most farms. IPM will ensure stink bugs populations are kept below economic injury levels. Like most other pests. Stink bugs have natural enemies such <i>Trissolcus basalis</i> parasitoids. Therefore, improving diversity, by planting wild flower strips in bean fields and hedge rows, will enhance the population beneficial insects.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures

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


	<p>disseminations</p> <ul style="list-style-type: none"> • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling,if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 2,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. Total basic costs; KES 10,000
Estimated returns	<p>Estimated returns 840kg/acre x KES100= KES 84,000 per acre / per season</p> <p>Farmers who do not use the IDM package lose 58% of KES 84,000 (ie a loss of 48, 720) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)</p>
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on sting bung
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • Plantwise Knowledge Bank
F: Status of TIMP readiness (1- Ready for upscaling, 2- requires validation, 3-requires further research)	1-Ready for upscaling,
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471</p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: info.ptc@kalro.org; Telephone: +254-0727615868</p>
Lead organization and scientists	KALRO-Muguga/Kabete/Katumani, Berrick Ochieng., Ruth Amata.,and David Karanja
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

- I. Explore the use of ITKs in management of stink bug in beans

2.7.13 TIMP name	Integrated Management for looppers (<i>Autographa californica</i>) in beans
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	 <p>loopers (<i>Autographa californica</i>) Source:UC-IPM</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss of between 12-30% attributed to loopers
What is it? (TIMP description)	<p>Integrated pest management (IPM) of Loopers involves the combination of chemical, biological and cultural control methods. These are:</p> <p>Cultural control</p> <ul style="list-style-type: none"> • Regularly look for eggs and young caterpillars (larvae with short hairs along their backs) for timely control • Remove and destroy plant residues by burying immediately after harvesting. • Plough the soil after harvesting. This exposes pupae, which may then be killed by natural enemies or through desiccation by the sun • Handpick and destroy eggs and small caterpillars. This is feasible in small fields or when infestations are low. • Intercrop bean field with trap crops i.e. cereal crops then later destroying the trap crop to control the outbreak of corn earworm. • Crop rotation with non-legume crops i.e. crops from onion family • Avoid planting crops after each other that are susceptible to bollworm like cotton, maize, sorghum, tobacco, soybean, and tomato to reduce/prevent build up of bollworm populations • Grow maize as a trap crop at 10 m interval to reduce pod damage in beans • Cover the crop using agronets from KALRO to reduce pest infestation on the crop <p>Biological control</p> <ul style="list-style-type: none"> • Spray neem based products like neemroc EC and nimbecidine (Azadiractin) use 1 lts/acre (10 plastic bottle tops per 20 lts of water) to control the pest and help conserve egg parasitoids (e.g. Trichogramma spp.), larval parasitoids (wasps and flies that parasitise caterpillars), and predators such as ants, assassin bugs, minute pirate (anthocorid) bugs, lacewings and ladybird beetles. • Use of <i>Bacillus thuringiensis</i> at the recommended rates to control outbreaks. This can be purchased from Kenya Biologics • Use sticky pheromone traps at the rates of 24 pcs/acre to catch the adult flies from Koppert Kenya <p>Chemical control</p> <ul style="list-style-type: none"> • Spray Deltamethrin 5g/L e.g. Decis 0.5 ULV 10-15 ml in 20 liters of

	<p>water OR Atom 2.5 EC at rate of 10-15 mls in 20 liters of water</p> <ul style="list-style-type: none"> • Spray Bifenthrin 25g/L e.g. Biferan 25EC OR Seizer 80 SC at a rate of 20ml in 20 liters of water
Justification	<p>Bean loopers cause considerable reduction in yield and lower the quality beans. Where the pest is severe and not controlled yield is greatly reduced by over 50%, posing challenges and produce rejected. Integrated Management of pests considering food safety concerns should be highly advocated considering that beans are very widely consumed in Kenya</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<p>Farmers, Extension agents (Public and Private), Research Organizations and Universities, Bio-pesticides companies, CGIAR's</p>
Approaches to be used in dissemination	<ul style="list-style-type: none"> • On-farm trials and Demonstrations • ASK shows • Field days • Agricultural shows • Farmer research networks • Farmer to farmer • Mass media – Agricultural programs • Promotional materials (posters/brochures/leaflets, manuals) • Web material's • Digital platforms • Farmer Field and Business Schools (FFBS) • Agricultural innovation platforms • Print media brochures • Conferences and journals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Support Agro chemical companies to sell biological controls products • Create awareness of the benefits of the IPM management practices • Willingness of stakeholders to participate • Carry out Applied and adaptive research to validate IPM technologies on insects • Create a platform for interaction of bean value chain stakeholders • Farmers adopt appropriate agronomic practices • Form well organized farmer groups and networks • Formation of spray service providers (teams) to manage Insects • A strong partnership between technical personnel /Extension / companies producing biological control and biopesticides products and farmers would enhance promotion.
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension agents (both private and public): • Mobilization/sensitization of farmers and extension of the technology • Farmers/CBO: participate in trainings and adoption of the technology • KALRO to continually undertake research in insect management • PCPB to promote registration of insecticides for insect management


	<ul style="list-style-type: none"> • Universities to develop the technologies and conduct ToTs. • Farmers/farmer groups to adopt the technologies • County governments, central governments for development of enabling policies and create awareness. • CGIAR/NGOs to link farmers to the market and lobby for changes in agriculture policies to favour the farmer. • Financial institutions to provide credit facilities
C: Current situation and future scaling up	
Counties where already promoted, if any	Muranga, Embu, Meru, Nyandarua, Kiambu Nyeri, Narok, Kajiado, Uasin Gishu, Nakuru, Elgeyo Marakwet and Baringo
Counties where TIMPs 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"> • Unwillingness of farmers to adopt IPM technologies • Inadequate knowledge on IPM strategies on insect pests infesting bean and losses attributed to them • Poor linkages among stakeholders in bean value chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • PCPB enhance registration of crop protection products • Training of stakeholders in IPM options • Establish bean innovation platforms for technology disseminations • Dissemination of integrated pest management practices and safe use of pesticides • Promote appropriate marketing channels e.g. contract farming, collective production and marketing
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Sensitization is necessary for people to appreciate the use of IPM in insect management • Adoption of good agricultural practices by farmers is key in management of the insects • Chances of successful scaling are higher when many value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Favorable environmental conditions • Willingness of stakeholders to participate • Favorable environmental conditions • Regulatory bodies e.g. PCPBP, KBS to ensure insecticides sold to farmers are genuine and of high quality • Producers willing to adopt the insect management practices • Producers are organized in groups to ensure that management practices are effectively up-scaled • Farm input costs are within the reach of farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 4,000 as costs for insecticides and application per acre per season; KES 4000 per acre for insect traps. KES 2,000 as labor and other costs for implementation of the rest of management practices in

	the IDM package per acre. Total basic costs; KES 10,000 per acre
Estimated returns	Estimated returns 840kg/acre x KES100= KES 84,000 per acre Farmers who do not use the IDM package lose 12-30% of KES 84,000 (ie a loss of 10,080-25, 200) (Depending on levels of infestation, weather conditions and stage at which the pest affects the crop)
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs such as chemicals than men • Women have limited access to pest education, training and extension services than men • Women have less access to agricultural information, technology and knowledge on loppers
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop • Affirmative action funds exist for youths and women to access the required funds.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed exists in spraying the crop. • Affirmative action funds exist for youths and women to access the required funds.
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • <u>R.F. Long</u>, UC Cooperative Extension Yolo County • <u>P.B. Goodell</u> (emeritus), UC IPM and Kearney Agricultural Research and Extension Center, Parlier • Acknowledgement for Contributions to Insects, Mites, and Other Invertebrates L.D. Godfrey, Entomology, UC Davis
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	<p>The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471</p> <p>Director - KALRO Seeds; P.O. Box 6223 01000 Thika: Email: info.ptc@kalro.org; Telephone: +254-0727615868</p>

Lead organization and scientists	KALRO-Muguga/Kabete/Katumani, Berrick Ochieng, Ruth Amata., and David Karanja
Partner organizations	CABI, ICIPE, KEPHIS, Real IPM, Koppert, Universities, County governments

Research Gaps:

1. Explore the effectiveness of all registered fungal and bacterial based biopesticides for control of loopers
2. Assess the use of ITKs in pest management

2.7.14 TIMPs Name	Integrated Management of root knot nematodes in Beans
	 <p>Root knot nematode (<i>Meloidogyne</i> spp.) (Source; Infonet Biovision)</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to root knot nematodes
What is it? (TIMP description)	For root knot nematodes affecting beans, the Integrated Pest Management (IPM) package involves cultural practices including crop rotation with crops in the grass family for 4-6 seasons. The pest has a wide host range hence the need to be careful when choosing rotation crops, with grasses being poor hosts, hence a better rotation crop. Avoidance of surface run off as it spreads the pest to non-infected areas, uprooting affected plants and burning. Solarization whereby fields that are severely affected are ploughed and exposed to the effects of high temperatures from the sun during dry hot months. Drench soils using biopesticides (Achook, Nimbecidine and Trianum P.)

Justification	Root knot nematodes are a major challenge in a wide range of crops including Dry bean. Losses of 20-90% may be experienced depending on nematode populations and how early the crop is affected. The pest occurs in all soil types. It is most severe where host crops are planted season after season. Failure to observe crop rotation with non-host crops e.g (grasses) which are poor hosts would lead to higher severity cases. This has to be combined with the use of other control measures including solarisation, cultural practises that enhance field hygiene and use of biopesticides.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> - Farmers - Extension Agents (Public and Private) - Research organizations and universities
Approaches to be used in Dissemination	<ul style="list-style-type: none"> - Extension publications - On-farm demonstrations - Farmer field days - Farmer training <ul style="list-style-type: none"> - Agricultural shows and exhibitions - Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> - Strong partnership linkages - Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. - Accessibility and cost of the practice by farmers: low- cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> - Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farmdemonstrations; capacity building of farmers - County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Counties where beans do well
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources.
Suggestions for addressing the challenges	Training on integrated pest management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the pest.
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of major diseases IDM is environment friendly and the synthetic chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers


	<p>to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption</p> <ul style="list-style-type: none"> • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
D: Economic, gender, vulnerable and marginalized groups (VMGs) Considerations	
Basic costs	<ul style="list-style-type: none"> • KES 2000 as costs for nematicides and biopesticides application per acre per season; KES 3000 as costs for implementation of other management practices in the IDM package per acre. Total basic costs; KES 5,000 per acre / per season.
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg/acre x KES100= KES 84,000 per acre / per season • Farmers who do not use the IDM package could loss 20-90% of KES 84,000 • Losses experienced range from KES 16,800-KES 75,600 Estimated returns in KES when IDM package is not used range from KES 8,400 to 67,200 per acre / per season
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for Users	<ul style="list-style-type: none"> • Bean IPM. Major Plant Parasitic nematodes. J.RKikkert and G.S Abawi. Bean ipm.pbgworks.org • Dry Bean Diseases. University of Nebraska-Lincoln • Quick guide to insects & diseases of beans. Extension.umn.edu • Bean. Infonet Biovision

F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires furtherresearch)	1-Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email; cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO Kabete., Ruth Amata., KALRO Katumani David Karanja, Daniel Mutisya., Sila Nzioki, David Karanja and KALRO Muguga South., Harun Odhiambo
Partner organizations	<ul style="list-style-type: none"> • Extension service providers • CGIAR's • Extension service providers • NGOs • County governments

Research Gaps:

Explore Bio-control options (Achook, Nimbecidine and Triatum P.) for management of root-knot nematodes of beans in various soil types

Bean Diseases

2.7.15 TIMP name	Integrated Management of Bean rust (<i>Uromycesappendiculatus</i>)
	 <p>(Picture source; Ruth Amata, KALRO)</p>
Category (i.e. technology, innovation or management practice)	Management practice
Description of the technology, innovation or management practice	
Problem addressed	Yield losses due to bean rust disease
What is it? (TIMP description)	Integrated Disease Management (IDM) package for bean rust, includes the use of clean bean seed, seed dress with pesticides

	including Murtano Super or Apron star 42WS. Cultural practices including crop rotation with non-legumes for 2-3 seasons, appropriate spacing to reduce overcrowding which creates a microclimate and enhances disease spread, field hygiene including destruction of infected residues to reduce inoculum in the field, use of drip irrigation rather than overhead irrigation since the latter spreads the disease through splash. Eliminate volunteer bean crops which carry over inoculum from season to season. Avoid walking in fields with infected plants to minimize spread. Control weeds since some serve as alternative hosts. Chemical control with recommended relatively safe (WHO class III) fungicides including Affair Top, Saaf WP, Amicop 50WP and King 250EW according to manufacturers' recommendations.
Justification	Rust is a major challenge in bean production in Kenya, occurring in all major production areas and causing losses of 30-50% depending on severity. The pathogen produces abundant spores which are airborne, spread easily through air and splash and cover leaves reducing the plants photosynthetic area. The earlier the infection, the more severe the disease which causes leaf fall. Integrated Disease Management is an environmental friendly approach to disease control which enables the use of various strategies to alleviate yield loss due to diseases.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> - Farmers - Extension Agents (Public and Private) - Research organizations and universities - CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> - Extension publications - Farmer Field & Business Schools - On-farm demonstrations - Farmer field days - Farmer training - Agricultural shows and exhibitions
	<ul style="list-style-type: none"> - Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> - Strong partnership linkages - Need for farmer participatory involvement which helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. - Accessibility and cost of the practices by farmers: low- cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> - Extension service providers (Public and private) to help in the dissemination - CGIAR's - NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers


	- County governments –Help in the dissemination of the Management practices
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Nyeri
Challenges in dissemination	<ul style="list-style-type: none"> • Limited knowledge on integrated disease management options • Farmers with small farms may not effectively practice crop rotation for the 2-3 seasons recommended • Farmers with limited economic resources may not afford fungicides
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Training on various integrated disease management practices (use of clean seed, field sanitation, tolerant varieties) in managing the disease to minimize losses and increase yields • Farmers could use various other alternative management practices from the package • Farmer field and business schools where farmers implement alternative management practices in a participatory manner.
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of major diseases so that farmers may select those easily accessible to them • IDM is environment friendly and the chemical option should be used as the last resort • Participatory, farmer-centered approaches which are affordable and practical could be used to minimize diseases • Farmers are encouraged to participate in the disease management practices to enhance understanding and adoption • IDM approaches are knowledge intensive and location specific. • Farmers need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Availability of markets and favourable prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 1500 as costs for fungicides and application per acre per season; KES 3500 as costs for implementation of other management

	<p>practices in the IDM package per acre. Total basic costs; KES 5,000.</p> <ul style="list-style-type: none"> • Other initial costs for new farmers (One off); Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000 - One off cost)
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg per acre x KES 100= KES 84000 per acre / per season • If a farmer does not use the IDM package they would lose 30-50% of KES 84,000 • Losses of KES 25,200-42,000 experienced. Hence returns reduced to KES 58,800 to 42,000 when the IDM package is not used.
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Plantwise Fact sheets for Farmers. Bean Rust Management Plantwise Knowledge Bank Beans. Infonet Biovision
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	Some management options require validation e.g Tolerance of new bean varieties to rust /diseases and upscaling e.g new varieties planted in new regions.
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete P.O. Box 14733-00800, Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and Scientists	KALRO- Kabete / Katumani. Ruth Amata., Daniel Mutisya., Karanja D., Nzioki C., Odhiambo H.
Partner organizations	<ul style="list-style-type: none"> • Extension service providers • CGIAR's • NGOs • County governments

	<ul style="list-style-type: none"> • Help in the dissemination of the technology,
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Research Gaps:

Determine tolerance of new bean varieties to bean rust disease in various AEZ's
 Explore the use of ITKs in bean rust disease management

2.7.16 TIMP name	<p>Integrated Management of anthracnose disease of beans</p>  <p style="text-align: center;">Anthracnose on pods and leaves (Source: Ruth Amata, KALRO)</p>
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss and low grain quality due to disease
What is it? (TIMP description)	The Integrated Disease Management (IDM) package for anthracnose disease involves starting off with certified seed/disease free seed since the disease is seed borne. Where seed is being re-used, seed dress with pesticides including Murtano Super or Apron star 42WS. Use of cultural, biological and chemical control methods are used. Cultural control involves rotation of the bean crop with non-legumes for 3-4 seasons (at least 2 years), field hygiene including destruction of infected plant residues to reduce inoculum in the field through burying 2 feet deep. Use recommended spacing to avoid overcrowding which enhances disease spread. Chemical control involves using recently registered safe fungicides (WHO III) such as Bendazim 500SC and Affair Top 800WDG according to manufacturer's recommendations.
Justification	Anthracnose is a seed borne disease posing major challenges in bean production in Kenya. It occurs in all major production areas. The disease is severe during cool wet conditions. It causes significant yield loss (up to 20-70% where not controlled where seed is re-used) both in terms of quantity and quality. Since it is a seed-borne disease it is very common in areas where farmers recycle their own saved seed. It is a quarantine disease which leads to rejection during inspection, where farmers are growing seed bean.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension Agents (Public and Private) • Research organizations and universities


Approaches to be used in dissemination	<ul style="list-style-type: none"> • Extension publications • Farmer field and business schools • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Strong partnership linkages • Need for farmer involvement to generate and tap into locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments –Help in the dissemination of the management practices
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	In counties where the crop does well.
Challenges in dissemination	<ul style="list-style-type: none"> • Farmers are not receptive to cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land parcels and limited economic resources. • Anthracnose disease is seed borne and thus use of recycled seed contributes to increased spread
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage farmer groups to hire additional land and adopt Integrated disease management practices in managing diseases to minimize losses and increase yields. • Better reliable markets for increased profitability so that farmers are able to buy certified seed.

Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of major diseases • IDM is environment friendly and the chemical component should be used judiciously as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate to enhance adoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand their agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain and offer favourable prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 1500 as costs for fungicides and application per acre per season; KES 2000 as labor costs for implementation of other management practices in the IDM package per acre. KES 1666 if buying certified seed which the farmer may re-use for three repeat seasons thereafter (ie KES 5000/3 seasons) Total basic costs; KES 5,166 per acre / per season
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg per acre x100kg = KES 84,000 per acre / per season • Use of the IDM package would lead to a loss of 20-70% of KES 84,000 • Losses experienced range from KES 16,800 to 58,800 • Estimated returns when IDM package is not used range from KES 25,200 to 67,200
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities.

up	<ul style="list-style-type: none"> • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for Users	<ul style="list-style-type: none"> • Beans. Infonet Biovision • Quick guide to insects and diseases. Extension. Umn.edu
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	<ul style="list-style-type: none"> • Cultural practices are ready for up-scaling • Some management options require validation e.g the tolerance/ resistance of new varieties to diseases needs to be established in new regions
G: Contacts	
Contacts	Centre Director KALRO Kabete, P.O. Box 14733 00800 NBI cd.narl@kalro.org Phone: 0727624471
Lead organization and Scientists	KALRO-Kabete / KALRO Katumani, Ruth Amata., Daniel Mutisya., Nzioki C., and David Karanja
Partner organizations	<ul style="list-style-type: none"> - Extension service providers - FAO - NGOs - County governments - Help in the dissemination of the technology,

Research Gaps

1. Determine performance of new bean varieties in new areas with respect to anthracnose disease
2. Explore Bio-control option for disease management
3. Explore the use of ITK's in disease management

2.7.17 TIMP name	<p>Integrated Management of powdery mildew of beans</p>  <p>Powdery mildew (<i>Erysiphe polygoni</i>) (Source; Sila Nzioki KALRO)</p>
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Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Yield loss due to powdery mildew disease of beans
What is it? (TIMP description)	The Integrated Disease Management (IDM) of powdery mildew involves the use of clean seed. Where seed is being re-used, seed dress with pesticides including Murtano Super or Apron star 42WS. Use cultural practices including, rotation of bean crop with non-legumes for 2-3 seasons, appropriate spacing to enhance aeration and reduce overcrowding which creates a microclimate and enhances disease spread, Practise field hygiene by burying infected residues 2 feet deep. Use bicarbonate of soda 1tsp in 1 litre of water (indigenous technical knowledge (ITK)), during the initial stages of disease development to prevent disease establishment, Use of biodewcon (bio-pesticide) where available before disease becomes severe. Use of synthetic chemical control with recommended registered relatively safe fungicides (WHO class III) including Domain 25% , Explorer 0.3SL or Iprode 500SC.
Justification	Powdery mildew disease is a major challenge in bean production in Kenya, occurring in all major production areas. The disease is severe because the pathogen produces abundant spores which cover leaves reducing the plants photosynthetic area. This causes significant yield loss of up to 30-70% where the disease is not controlled and where previous seed is recycled. Under severe infection, it causes leaf fall. Integrated Disease Management is an environmental friendly approach to disease control which enables the alleviation of yield loss due to disease damage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training

Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and • Accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments –Help in the dissemination of the management practice
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Counties where beans perform well
Challenges in dissemination	<ul style="list-style-type: none"> • Farmers may not implement some of the practices e.g. Crop rotation small farms and limited economic resources. • Farmers may not be able to use fungicides due to lack of funds • Bio-pesticides may not be available in local agrovets close to the farmers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage farmer groups to hire additional land and adopt integrated disease management practices in managing diseases to minimize losses and increase yields. • Better reliable markets for increased profitability to enable farmers buy certified seed
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> - Several approaches are used in integrated management of major diseases - IDM is environment friendly and the chemical component should be used as the last resort - Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption - IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the
	diseases once they become a problem. This will require a capacity

	building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> - Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices - Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM - Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 1500 as costs for fungicides, ITKs and application per acre per season; KES 3,500 as costs for implementation of other management practices in the IDM package per acre. Total basic costs; KES 5,000 per acre / per season.
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg per acre x KES 100= KES 84000. If a farmer does not use the IDM package they would lose 30-70% of KES 84,000. • Failure to use the IDM package would lead to a loss of 30-70% of KES 84,000 • Losses experienced range from KES 30-70% (KES 25,200-KES 58,800) • Estimated returns in KES when IDM package is not used range from KES 25,200 to 58,800 per acre / per season
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.



VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • Beans. Infonet Biovision • Quick guide to insects and diseases. Extension. Umn.edu
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	<ul style="list-style-type: none"> • Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi
	Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and Scientists	KALRO-Kabete,; Ruth Amata., KALRO Katumani David Karanja, Daniel Mutisya.,
Partner organizations	<ul style="list-style-type: none"> - Extension service providers - CGIAR's - NGOs - County governments - Help in the dissemination of the technology,

Research Gaps:

Explore the effectiveness of bio-control options e.g biodewcon for managing powdery mildew disease in different bean varieties

Explore the use of ITKs in disease management of the different bean varieties

Assess the tolerance of the bean varieties to powdery mildew in the various AEZ's

<p>2.7.18 TIMP name</p>	<p>Integrated Management of leaf spots of beans</p>  <p>Angular leaf spot disease (<i>Phaeoisariopsis griseola</i>,sp.) (Source; Ruth Amata KALRO)</p>
	 <p>Cercospora leaf spot disease (<i>Cercospora</i> sp.) (Source; Ruth Amata KALRO)</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p>A: Description of the technology, innovation or management practice</p>	
<p>Problem addressed</p>	<p>Yield loss due to leaf spot diseases caused by fungal diseases including angular leaf spot and Cercospora</p>
<p>What is it? (TIMP description)</p>	<p>The Integrated Disease Management (IDM) package for leaf spots includes use of clean seed. Where seed is being recycled, seed dress with pesticides including Murtano Super or Apron star 42WS. Cultural control</p>

	in this case involves rotation of beans with non-legumes for at least 2-3 seasons, field hygiene by burying all crop residues 2 feet deep, destroy all volunteer crops as these carry over disease inoculum from season to season. Chemical control as a last control option where disease levels are severe, will be applied in an alternating manner using relatively safe fungicides (WHO class III) including Iprode 500SC, Domain 25% EC and Affair Top.
Justification	Cercospora and angular leaf spot diseases are major diseases of bean in Kenya. They occur in all major production areas. The diseases cause significant yield losses of 20-50% where not controlled due to the damage they cause on leaves hence affecting photosynthetic area and yield. The Integrated Disease Management package reduces overdependence on pesticides as it enables the use of various alternative management strategies hence contributing to a safer environment and better human health.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Extension publications • On-farm demonstrations • FFBS • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Strong partnership linkages • Farmer involvement will be necessary for successful implementation and sustainable use of the IPM package. • Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low- cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to helpin the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will	Counties where the bean crop does well

be upscaled	
Challenges in dissemination	Farmers are not receptive to some of the cultural methods of managing diseases e.g. Crop rotation which is difficult to implement for farmers with small land holdings and limited economic resources.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Participatory implementation of the management practices e.g. under field demonstrations following which farmers may adopt based on crop performance. • Encourage farmers/groupsto hire additional land and adopt integrated disease management practices in managing diseases to minimize losses and increase yields. • Better reliable markets for increased profitability to motivate the farmers and to enable them pay for the management practices
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of major diseases • IDM is environment friendly and the chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 1500 as costs for fungicides and application per acre per season; KES 2000 as labor costs for implementation of other management practices in the IDM package per acre. Total basic costs; KES 3,500 per acre / per season
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg per acre x KES 100= KES 84000 per acre / per season • If a farmer does not use the IDM package they would lose 20-50% of KES 84,000 • Losses experienced range from KES 20-50% (KES 16,800-KES

	42,000) <ul style="list-style-type: none"> Estimated returns in KES when IDM package is not used range from KES 42,000 to 67,200
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> Women and youth have limited access to productive resources such as credit to purchase the required inputs Women have limited access to education, training and extension services than men. Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have limited access to credit to buy the required inputs such as chemicals. VMGs have limited access to training and extension services. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Dry bean diseases. University of Nebraska-Lincoln Quick Guide to insects and diseases of beans. Extension .umn.edu Beans. Infonet Biovision
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800NairobiEmail: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO-Kabete, Ruth Amata., Daniel Mutisya., Nzioki C., and David Karanja
Partner organizations	<ul style="list-style-type: none"> Extension service providers FAO NGOs County governments Help in the dissemination of the technology,



Research Gaps:

Explore Bio-control options for management of angular and cercospora and angular leaf spot diseases

Explore the use of ITKs in bean leaf spot disease management

Farmer participatory evaluation of the management of leaf spots using bio-pesticide

Planting tolerant bean varieties for validation and up-scaling them in respective counties based on their tolerance/resistance to the diseases

<p>2.7.19 TIMP name</p>	<p>Integrated Management of root rot and Fusarium wilt diseases of beans</p>  <p>Dry Root rot (<i>Fusarium solani</i> fsp. <i>phaseoli</i>.) (Source; vegetablemdonline.ppath.cornell.edu)</p>
	 <p>Fusarium wilt disease (<i>Fusarium oxysporum</i>)(source grdc.com.au)</p>
<p>Category (i.e. technology, innovation or management practice)</p>	<p>Management practice</p>
<p>A: Description of the technology, innovation or management practice</p>	
<p>Problem addressed</p>	<p>Yield loss due to disease</p>
<p>What is it? (TIMP description)</p>	<p>Integrated Disease Management (IDM) package for dry root rot and Fusarium wilt disease of beans includes the use of Trichoderma based biological control agents e.g Rootgard and validating products including, Eco-T, Trianum P 11.5WP and Trichotech, Rootgard and Biocure F at planting. It also includes the use of cultural practices including crop rotation with non-legumes for 6-8 seasons (3-4 years) since the pathogen is able to last long in the soil, practising field hygiene, avoidance of excessive watering when irrigating, avoid surface run off</p>



	<p>as it spreads the pathogen to non- infected areas, uprooting affected plants and burning to reduce inoculum, disinfecting farm tools in jik solution (50ml : litre) to prevent spread. Judicial use of relatively safe (WHO class III) soft pesticides including cabendazim based products e.g Rodazim and Bendazim before the disease becomes severe and widely spread.</p>
Justification	<p>Dry root rot and Fusarium wilt diseases are soil borne diseases that are a major challenge in bean production in Kenya. Losses of 30-70% may be experienced where the disease is spread through surface run-off water. Failure to observe crop rotation would lead to higher severity cases and spread of the disease. It causes significant yield loss because it blocks the vascular system of the plant preventing water and nutrient uptake. Integrated Disease Management is an environmental friendly approach that enables the control of the disease through recommended cultural practices, use of biopesticides and synthetic pesticides.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low- cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help in the dissemination • CGIAR's • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments contribute to dissemination of management practices

C: Current situation and future scaling up	
Counties where already promoted, if any	Kakamega All bean growing areas
Counties where TIMPs will be upscaled	Counties favorable for bean production where farmers prioritize the crop
Challenges in dissemination	Farmers may not implement some of the practices e.g. Croprotection small farms and limited economic resources.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease. • Farmers may hire additional land to be able to practice crop rotation alongside other management practices
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of major diseases • IDM is environment friendly and the synthetic chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand the agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • KES 2000 as costs for fungicides and biocontrol agents and application per acre per season; KES 2000 as costs for implementation of other management practices in the IDM package per acre. Total basic costs; KES 4,000 per acre / per season
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg/acre x KES 100= 84,000 per acre / per season • Farmers who do not use the IDM package would lose 30-70% of KES 84,000 • Losses experienced range from KES 30-70% (KES 25,200-KES 58,800) • Estimated returns in KES when IDM package is not used range

	from KES 25,200 to 58,800
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for Users	<ul style="list-style-type: none"> • Dry Bean Diseases. University of Nebraska-Lincoln • Quick guide to insects & diseases of beans. Extension.umn.edu • Bean. Infonet Biovision • Integrated management of Bean Diseases (KALRO/KCSAP Fact sheet 2022)
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1. Ready for up-scaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and Scientists	KALRO-Kabete, Ruth Amata., KALRO Katumani Daniel Mutisya., Nzioki C., and David Karanja
Partner organizations	<ul style="list-style-type: none"> • Extension service providers • CGIAR's • NGOs • County governments • Help in the dissemination of the technology,

Research Gaps

- Explore the effectiveness of all registered Trichoderma based biopesticides for control of root rots and Fusarium wilt under different soil conditions
- Bean varieties will be validated and up-scaled for their relative tolerance/resistance to dry rot disease in respective counties
- Assess the use of ITKs in soil borne disease management

<p>2.7.20 TIMP name</p>	<p>Integrated Management of halo blight and bacterial leaf blight diseases of beans</p>  <p>Halo blight disease of beans (Source; Ruth Amata, KALRO)</p>  <p>Bacterial leaf blight of beans (Source; Sila Nzioki KALRO)</p>
	<p>Category (i.e. technology, innovation or management practice)</p>
<p>A: Description of the technology, innovation or management practice</p>	

Problem addressed	Yield loss due to disease bacterial blight diseases (halo blight and bacterial leaf blight of beans)
What is it? (TIMP description)	<p>For halo blight disease of beans, the Integrated Disease Management (IDM) package involves use of certified seed, since haloblight disease is seed borne. practicing crop rotation with non-legume crops for 3-4 seasons (2 years), Cultural practices including, uprooting and destroying infected plants/volunteers by burying 2 feet deep, disinfecting farm tools in jik solution (50ml:litre) and avoidance of working in wet fields. Scout fields and use copper based fungicides including Funguran OH 50WP, Vitra 40 WG, and Champflo SC as these protect against early development of bacterial spores.</p> <p>For bacterial leaf blight disease of beans, the Integrated Disease Management (IDM) package involves cultural practises including crop rotation with non-legumes for a period of 2 to 3 seasons, roguing out infected plants from the farm and burying 2 feet deep, Avoidance of working in the fields when plants are wet to minimize spread, disinfecting farm tools in jik solution (50ml:litre). Use of copper based fungicides which are synthetic pesticides including Funguran OH 50WP, Vitra 40 WG, and Champflo SC as these protect against early development of bacterial spores</p>
Justification	Halo blight disease is a serious seed borne quarantine disease affecting bean production in Kenya. It occurs in all production areas, but is more severe in some regions. Presence of the disease on seed producing farms leads to total crop rejection during inspection by KEPHIS. It causes significant yield loss because it disables the ability of the plant to photosynthesize. Losses of 20-70% is experienced where the disease is not controlled and previous season's seed is used. Integrated Disease Management is an environmental friendly approach that enables the control of the disease through cultural and chemical practices that prevent on farm spread hence reducing yield loss.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension Agents (Public and Private) • Research organizations and universities • CGIAR's
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Extension publications • On-farm demonstrations • Farmer field days • Farmer training <ul style="list-style-type: none"> • Agricultural shows and exhibitions
	<ul style="list-style-type: none"> • Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous

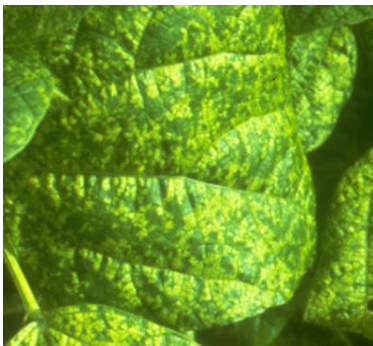

	<p>Traditional Knowledge (ITK) can be promoted and adopted faster.</p> <ul style="list-style-type: none"> • Accessibility and cost of the practice by farmers: low-cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private)-dissemination • CGIAR's to disseminate and promote management practices • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments – Sensitize farmers and disseminate the management practices through their County extension staff
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Counties where beans are grown
Challenges in dissemination	Farmers may not implement some of the practices e.g. Crop rotation due to small farms and limited resources.
Suggestions for addressing the challenges	Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation, biological control, tolerant varieties and use of ITK's) in managing the disease. The farmers could choose among the options
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of major diseases • IDM is environment friendly and the synthetic chemical component should be used as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption • IDM approaches are knowledge intensive and location-Specific. Farmers would need to understand the agro-ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid the disease. This will require capacity building on crop monitoring and ecological principles.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices • Training on IDM to increase awareness of IDM and reduce possible negative impact on the environment resulting from wrong application of IDM • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 1500 as costs for copper based fungicides for protection against bacterial diseases and application per acre per season; KES 1000 as labor costs for implementation of other management practices in the IDM package per acre. Since the disease is seed borne, KES 1666 is needed for buying certified seed which the farmer may reuse for three repeat seasons thereafter (ie KES 5000/3 seasons) Total basic costs; KES 4,167.

	(Other initial costs for new farmers; Knapsack sprayer KES 2,000-10,000; Protective gear KES 4000).
Estimated returns	<ul style="list-style-type: none"> • Estimated returns are 840kg per acre x KES 100= KES 84,000 per acre / per season • If the farmer does not use the IDM package they would lose 20-70% of KES 84,000 • Losses experienced range from KES 20-70% (KES 16,800-KES 58,800) • Estimated returns in KES when IDM package is not used range from KES 25,200 to 67,200 per acre / per season
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	<ul style="list-style-type: none"> • Dry Bean diseases. University of Nebraska-Lincoln • Quick guide to insects & diseases of beans. Extension.umn.edu • Beans. Infonet Biovision
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1-Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and scientists	KALRO-Kabete, Ruth Amata., KALRO Katumani Daniel Mutisya., Nzioki C., and David Karanja
Partner organizations	<ul style="list-style-type: none"> • Extension service providers • CGIAR's • NGOs • County governments

	<ul style="list-style-type: none"> • Help in the dissemination of the management practices
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Research Gaps

Assess the tolerance of the bean varieties to bean bacterial diseases in the various AEZ's

2.7.21. TIMPs name	Integrated Management of Bean Yellow Mosaic and Bean Common Mosaic Viral diseases	
		
	<p>Bean Yellow Mosaic. Source: University of Carlifonia</p>	<p>Bean common mosaic . Source: apps.lucidcentral.org UC. IPM</p>
Category (i.e. technology, innovation or management practice)	Management practice	
A: Description of the technology, innovation or management practice		
Problem addressed	Reduced quantity and quality of yield due to high incidences of bean diseases	
What is it? (TIMP description)	For Yellow Mosaic and Bean Common Mosaic viral diseases, the Integrated Disease Management (IDM) package involves use of certified seed, monitoring insect vectors that transmit the virus, avoiding working in fields when wet to prevent spread, uprooting weeds that could serve as alternative hosts and use of bio-pesticides such as Botanigard ES, Biocatch 1.15WP, Nimbecidine EC, Achook 0.15% EC and Neemraj Super 3000. The use of Yellow Sticky Traps and Female pheromone traps have also been validated as effective methods for the control of aphids and whiteflies. Soft/relatively safe synthetic pesticides such as Calypso SC 480, Closer 240SC and Eabcl Contest 5.7 WDG to control the vectors. Bean varieties will be upscaled for their relative tolerance/resistance to Yellow Mosaic and Bean Common Mosaic	
	Mosaic diseases in respective counties. Use of soft/safe synthetic pesticides will only be recommended registered asa last option.	
Justification	Yellow Mosaic and Bean Common Viral diseases are major challenges in bean production in Kenya, occurring in all major production	

	<p>areas. The Yellow Mosaic disease is vectored by both aphids and whiteflies while Bean Common Mosaic disease is predominantly vectored by aphids. This implies that the control of these two major viral diseases of beans is pegged on the control of aphids and whiteflies. They cause significant yield losses (20-50% especially where infected seed is used) because they disable the ability of the plants to photosynthesize. Integrated Disease Management is an environmentally friendly approach that enables the control of the diseases through control of vectors and cultural practices that prevent on farm spread hence reducing yield loss.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension Agents (Public and Private) • Research organizations and universities
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Extension publications • On-farm demonstrations • Farmer field days • Farmer training • Agricultural shows and exhibitions • Farmer to farmer training
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Strong partnership linkages • Need for farmer involvement helps generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to them e.g. Use of Indigenous Traditional Knowledge (ITK) can be promoted and adopted faster. • Accessibility and cost of the practice by farmers: low- cost agricultural practices are easily promoted and accepted
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Extension service providers (Public and private) to help • in the dissemination • CGIAR's
	<ul style="list-style-type: none"> • NGOs: technology dissemination through on-farm demonstrations; capacity building of farmers • County governments –Help in the dissemination of the technology
C: Current situation and future scaling up	
Counties where already promoted, if any	-
Counties where TIMPs will be upscaled	Counties where beans do well
Challenges in dissemination	<p>Farmers are not receptive to cultural methods of managing diseases e.g. Crop rotation is difficult to implement for farmers with small land holdings and limited economic resources. The Yellow Mosaic viral disease is seed borne and thus use of recycled seed limits disease control</p>
Suggestions for addressing the challenges	<p>Training on integrated disease management practices (use of clean seed, field sanitation, crop rotation) in managing diseases Building capacity among farmers to understand the need to procure</p>

	certified seeds after every three seasons to minimize on buildup of seed borne diseases
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • More than one approach is used in management of • major diseases • IDM is environment friendly and the chemical component should be used judiciously as the last resort • Participatory, farmer-centered approaches, which encourage farmers to participate in the innovation process and the facilitation of experimentation among farmer communities in the evaluation of the technology enhances technology adoption • IDM approaches are knowledge intensive and location- specific, farmers would need to understand their agro- ecological processes affecting the disease to be able to make informed decisions on how to manage crop to avoid disease occurrence, as well as how to manage the diseases once they become a problem. This will require a capacity building on crop monitoring and ecological principles.
D: Economic, gender, vulnerable and marginalized groups (VMGs)	
Considerations	
Basic costs	<ul style="list-style-type: none"> • KES 1500 as costs for insecticides and application per acre per season; KES 2000 per acre for insect traps. KES 2,000 as labor and other costs for implementation of the rest of management practices in the IDM package per acre. KES 1666 if buying certified seed which the farmer may reuse for three repeat seasons thereafter (ie KES 5000/3 seasons) Total basic costs; KES 7,167 per acre / per season
Estimated returns	<ul style="list-style-type: none"> • Estimated returns 840kg/acre x 100= KES 84,000 per acre/ season • Farmers who do not use the IDM package lose 20-50% of KES 84,000 • Losses experienced range from KES (KES 16,800-KES 42,000) • Estimated returns in KES when IDM package is not used range from KES 42,000 to 67,200 per acre/ per season
Gender issues and concerns in development, dissemination adoption and scaling up,	<ul style="list-style-type: none"> • Women and youth have limited access to productive resources such as credit to purchase the required inputs • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities for youths exists in spraying the crop.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to buy the required inputs such as chemicals. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities for unemployed youths in spraying the crop.

E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for Users	<ul style="list-style-type: none"> • Dry Bean Diseases. University of Nebraska-Lincoln • Quick guide to insects & diseases of beans. Extension.umn.edu • Bean. Infonet Biovision
F: Status of TIMP readiness (1-Ready for upscaling, 2-requires validation, 3-requires further research)	1- Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-Kabete; P.O. Box 14733-00800 Nairobi Email: cd.narl@kalro.org Phone: 0727624471
Lead organization and Scientists	KALRO-Kabete, Ruth Amata., Daniel Mutisya., Nzioki C., David Karanja and Harun Odhiambo
Partner organizations	<ul style="list-style-type: none"> - Extension service providers - FAO - NGOs - County governments - Help in the dissemination of the technology,

Research Gaps

Explore Bio-control options (Achook, Nimbecidine and Triatum P.) for management of Bean Common Mosaic disease and Yellow Mosaic viral disease of beans

2.8 Post Harvest Management of Dry Beans

2.8.1. TIMP Name	Solar Bubble Drier (SBD)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Post-harvest losses (bean discolouration and rotting) due to delayed drying. Additionally, with climate change, the weather has become unpredictable, thus, making grain open sun drying more difficult for farmers.
What is it? (TIMP description)	The Solar Bubble Dryer (SBD) is a low-cost, portable, and innovative sun-drying technology. The SBD comes with a photovoltaic system that consists of solar panels, which generates the electricity needed for the drying process. Grain is dried in a plastic bubble thus protecting it from contamination or rain.
Justification	Proper and timely drying of grains ensures good quality produce, which can command a competitive market price. Traditional sun-drying takes long to completely dry the beans. It is also labour intensive airing the bean on a daily period. The method is beset with


	<p>problems like uneven drying or overheating, which causes grain breakage during milling, spillage, and contamination (e.g. animals, vehicles etc.) hence compromising quality.</p> <p>With SBD, the drying process is faster, more regulated, and cost-efficient as it does not require fuel or the power grid to operate. Additionally, the enclosed feature of the system protects the grains from spillage and foreign contaminants.</p> <p>The SBD is environment-friendly and helps in mitigation efforts since it harnesses the solar as natural energy and does not require fuel or carbon-emitting power sources.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Bean producers, grain offtakers and processors, Seed companies
Approaches used in dissemination	<ul style="list-style-type: none"> • Field demonstration and farmer field schools, extension publications, brochures, factsheets and operators manuals
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Best deployed with organized groups • Accessibility of SBD by farmers • Favourable policy – encouraging better prices for well-dried grain
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • GrainPro, CIAT-PABRA, KALRO • Financial institutions – provide credit to farmers to enable acquisition of SBD
C: Current situation and future scaling up	
Counties where already promoted. if any	Kiambu, Nakuru, Muranga and Nandi
Counties where TIMPs will be upscaled	Nyeri and Laikipia
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of local availability of SBDs • Initial cost of equipment could be a challenge to ownership. Price ranges from KES. 250,000 for the half-ton SDB to KES. 500,000 for the 1 MT SDB. • This is a new technology that has not been used widely. Farmers need to have the technical skills on how to assemble and use the equipment.
Recommendations for addressing the challenges	<ul style="list-style-type: none"> • Encourage group ownership of the SBD with rental lease out business model to generate revenues • Training of groups on assembly, operation and maintenance • Adopting public-private partnerships, so that the private sector can stock the SBDs closer to farmers • Farmer groups to be given affordable credit facilities to acquire the dryers
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Group ownership of SDB ensures affordability of the technology • Diversifying uses of SBD (drying various crops- cereals and vegetables, fruits) makes the technology attractive to the groups
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Group ownership is critical to spread costs and make the equipment affordable.

	<ul style="list-style-type: none"> The SDB is environment-friendly and helps in mitigation efforts since it harnesses the sun's natural energy and does not require fuel or carbon-emitting power sources.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> Price ranges from KES. 250,000 for the half ton SDB to KES. 500,000 for the 1 MT SDB.
Estimated returns	<ul style="list-style-type: none"> 800kg/acre @KES. 100/kg less the acquisition cost
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women have less access to information, technology and knowledge on the technology Women perform most of the crops drying activities so the technology will reduce their drudgery of work Women and youth have limited access to education, training and extension services than men Women and youths may have less access to credit to purchase the solar bubble drier
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in performing the task Affirmative action opportunities such as women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to agricultural information, technology and knowledge VMGs have limited access to training and extension services Due to their social status VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for some VMGs such as women in performing the task Affirmative action opportunities such as the women enterprise fund exists for them to access the required credit..
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> The technology has been tested by CIAT-PABRA and KALRO in Kiambu and Nakuru with bean and Amaranth farmers. In Thika with a private sector bean value addition partner. The technology is highly adapted across bean growing areas in Nyeri and Laikipia Counties.
Application guidelines for users	<ul style="list-style-type: none"> Technical after sale support teams and training manuals available from private company- GrainPro. Extension publications and manuals on postharvest management of beans
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	CIAT-PABRA P.O. Box 823-00621 Nairobi; KALRO

	Katumani, P.O. Box 340-90100 Machakos
Lead organization and scientists	<ul style="list-style-type: none"> CIAT- PABRA (Christine Chege and Eliud Karanja) and KALRO, Katumani (David Karanja)
Partner organizations	<ul style="list-style-type: none"> GrainPro, CIAT-PABRA, KALRO

Gaps

- Evaluate efficacy of SBD for use by farmers in Nyeri and Laikipia (validate the technology in different AEZs)
- Develop business model/enterprise for the VMG on the use of SBD
- Research on innovative investment options for farmers and farmer groups

2.8.2 TIMP Name	Hermitic Grain Storage Bags and Cocoons Techniques
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High postharvest losses of beans. Over 30% of beans is lost after harvest due to damage by grain storage pest. The situation is worse for beans where the bruchids are a major concern. Insect damage reduces quality of food at household level and formarkets.
What is it? (TIMP description)	 <p>Hermitic storage technology is a safe way of preserving grain in airtight and moisture-proof conditions. Gunny bag with two inner polythene linings. Dry beans (at 10% moisture content) to be stored is put inside the inner polythene bag which is then tied air-tight. The second polythene is also tied air-tight, followed by tying the outer gunny bag cover. This is a chemical-free storage of dry green gram and other food grains. Examples of hermitic storage techniques are the Purdue Improved Crop Storage (PICS) bags currently promoted by Bell Industries and the GrainPro SuperGrainbag (SGB) and storage cocoons by GrainPro. Hermitic bags are very effective in keeping off bean storage pests, the main one being bean bruchid. Grain can keep over one year inside the hermitic bags, if kept in a cool dry place, and other destructive agents e.g. rodents are kept at bay.</p>
Justification	Pests can cause loss of up to 100%. Hermitic bags prevents bruchid infestation during storage. Reducing post-harvest grain damage by insects will help contribute to longer storability of food availability at household level and guarantee ensure quality of grain and better prices from markets. Use of hermitic storage technologies reduces use of chemicals thus promotes safe food. Hermitic storage bags can be used repeatedly thus reducing cost of buying new bags every year. Will increase income of farmers and traders.
Region promoted	Major grain growing areas of Kenya (e.g. Uasin Gishu, Nandi and Trans Nzoia)
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Bean farmers, households, bean offtakers, schools

Approaches used in dissemination	<ul style="list-style-type: none"> • Demonstrations, displays at agroshops, posters, brochures, on-farm demonstrations, mass media – “<i>Shamba shape up</i>” and digital platform Apps.
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Presence of a functional supply chain of the bags by private sector and agrodealers • Postharvest trainers • Grain to be stored must be adequately dried to a moisture content of less than 10% • Other destructive postharvest agents must be controlled, e.g. rodents; the grains are to be stored in a cool dry place. • Favourable policy, encouraging better prices for high quality grain
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • Bell Industries, GrainPro, NGOs, Research organizations (KALRO, CIAT-PABRA and the Universities)
C: Current situation and future scaling up	
Counties where already promoted, if any	Nakuru, Kakamega, Nyeri, Laikipia, Muranga, Homabay, Migori, Bungoma, Trans Nzoia, Machakos, Makeni
Counties where TIMPs will be upscaled	Nyeri and Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> • Low level of awareness of the effectiveness of the hermetic storage bags • Availability of the storage bags at nearest agrodealers
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Step up promotion and demonstration especially with farmer groups • Strengthen the hermetic bags distribution network to target farmers
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Basic training on proper use is essential for optimal benefit from the hermetic storage bags. This includes proper drying and correct moisture content determination of grain before storage. Keeping off rodents is important
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Need to subsidize cost of production to make the bags affordable and available to majority of farmers. • Market able to absorb increased supply of grain
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • Bags available in various sizes with 50kg bag costing KES. 200 and the 100kg costing KES. 250. Cocoons (1-100MT) are available for large grain producers
Estimated returns	<ul style="list-style-type: none"> • Reduces postharvest losses by 100% • Estimated 800kg/acre yield @ KES. 100/kg less cost of the bags
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women may have limited access to education, training and extension services on the technology. • Women may have less access to agricultural information, technology and knowledge on the technology. • Women and youths may have less access to credit to purchase the hermetic bags

Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youths in supplying the hermetic bags to farmers and traders.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs may have less access to credit to purchase the hermetic bags. • VMGs may have limited access to education, training and extension services on the technology. • VMGs may have less access to agricultural information, technology and knowledge on the technology.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some of the VMGs such as youth in supplying the hermetic bags.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • Successfully applied by farmers for beans storage in major bean growing areas in Kenya
Application guidelines for users	<ul style="list-style-type: none"> • Hermitic storage bags come with guides on use; Training available from company and research and development partners
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	<ul style="list-style-type: none"> • (CIAT-PABRA), (KALRO Katumani)
Lead organization and scientists	<ul style="list-style-type: none"> • Boaz Waswa (CIAT-PABRA), Daniel Mutisya(KALRO Katumani), Francis Wayua (KALRO-Kakamega)
Partner organizations	<ul style="list-style-type: none"> • Bell Industries, GrainPro, CIAT-PABRA, KALRO

GAPs

- Assess post-harvest loss following adoption of hermitic storage bags
- Cost benefit analysis of using hermitic storage bags (bruchid). Research is needed on how to combine it with appropriate methods for control rodents
- Gross margins and cost-benefit analysis of the hermetic storage bags and Cocoons

2.8.3. TIMP Name	Hermetic Sealed Metal Silo (Grain Storage Silos)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Over 30% of grain is lost after harvest due to damage by grain storage pests. The situation is worse for beans where the bruchids are a major cause of post-harvest loss. Insect damage reduces quality of food at household level and for markets. For fear of insect damage, farmers are often forced to sell the produce at low price at harvest only to buy it a

	few months later at high price.
What is it? (TIMP description)	Hermetic Sealed Metal Silo (Grain Storage Silos) is a safe way of preserving grain in airtight conditions. Hermetic sealed metal silo (grain storage silos) protects produce against rodents, weevils, grain borers, moths among others. The silo has capability of killing pests through oxygen deprivation without applying pesticides that affect health of and consumers and environmental degradation. The containers are sealed tightly to prevent circulation of air thus denying breeding of pests during storage of grain.
Justification	Reducing post-harvest grain damage by insects will help contribute to longer storage of food availability at household level and guarantee quality of grain and better prices from markets. Use of hermetic storage technologies reduces use of chemicals thus promotes food safety. Hermetic Sealed Metal Silo (Grain Storage Silos) can be used repeatedly thus reducing cost of buying new bags every year. They can be used for multiple crops at different times of the cropping seasons.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Bean farmers, households, bean offtakers and schools
Approaches used in dissemination	<ul style="list-style-type: none"> • Demonstrations, posters and brochures
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Presence of a functional supply chain or fabricators of the metallic silos in target areas.
Partners/stakeholders for scaling up and their respective roles.	<ul style="list-style-type: none"> • East Africa Grain Council (EAGC), NGOs, Research organizations (KALRO, CIAT-PABRA, Universities); local jua kali artisans for fabrication of the metal silos
C: Current situation and future scaling up	
Counties where already	Nakuru, Machakos, Makeni, Kakamega, Busia
Promoted, if any	
Counties where TIMPs will be upscaled	Nyeri and Laikipia
Challenges in dissemination	<ul style="list-style-type: none"> • Level of awareness of the effectiveness of the hermetic storage silos • Limited availability of the storage silos at nearest shops or artisans workshops. • High initial capital investment
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Step up promotion and demonstration especially with farmer groups • Strengthen the hermetic bags distribution networks to target farmers • Train youth to fabricate storage silos for the target groups and members. • Avail appropriate financing to farmers to enable acquisition of the metal silos
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Training on proper use is essential for optimal benefit from the hermetic storage silos. This includes proper drying of grain before storage and how to eliminate oxygen in silo before closing it.
Social, environmental, policy	<ul style="list-style-type: none"> • Need for credit arrangement or subsidy to make the silos affordable to


and market conditions necessary for development and up-scaling	majority of farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	<ul style="list-style-type: none"> • The capacity of the silos ranges from 1, 8, 12 and 1,000 bags. • The cost of the facilities ranges from KES. 3,000 for one bag capacity, KES. 15,000 for eight bags and KES. 24,000 for the 12 bags capacity among other prices. • The bigger silos are popular with big institutions like schools, universities and millers.
Estimated returns	<ul style="list-style-type: none"> • Estimated returns for using the technology is approximately 800kg/acre per harvest @ KES. 100/kg = 80,000 less the acquisition cost
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women may have limited access to education, training and extension services on the technology. • Women may have less access to agricultural information, technology and knowledge on the technology. • Women and youths may have less access to credit to purchase the hermetic bags
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youths in supplying the hermetic bags to farmers and traders.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs may have less access to credit to purchase the hermetic bags. • VMGs may have limited access to education, training and extension services on the technology. • VMGs may have less access to agricultural information, technology and knowledge on the technology.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some of the VMGs such as youth in supplying the hermetic bags.
E: Case studies/profiles of success stories	
Success stories	<ul style="list-style-type: none"> • Technology evaluated by KALRO http://www.farmbizafrica.com/advertise/11-pest-control/2312-hermetic-metal-silos-help-farmers-save-25-per-cent-grain-losses-without-use-of-chemicals • Also evaluated in Ngata estate in outskirts of Nakuru by the then Ministry of Agriculture in collaboration with the East Africa Grain Council (EAGC). https://www.standardmedia.co.ke/article/2000174591/special-silo-that-keeps-weevils-at-bay-for-kenyan-farmers
Application guidelines for users	<ul style="list-style-type: none"> • Training available from fabricators/sellers of the metallic silos; Brochures, factsheets and manuals
F: Status of TAMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	2. Requires validation

G: Contacts	
Contacts	• KALRO Katumani
Lead organization and scientists	KALRO, Wanjala Nasirembe & Francis Wayuia
Partner organizations	East Africa Grain Council (EAGC), CIAT-PABRA,

Gaps

- Requires validation with the bean producers in the target counties
- Research on innovative investment options for farmers and farmer groups
- Cost benefit analysis of storing beans in metal silos

2.9 Dry bean Value Addition

2.9.1. TIMP Name	Value Added Dry Bean Grain
Category (i.e. technology, innovation or management practice)	Innovation 
A: Description of the technology, innovation or management practice	
Problem addressed	Low quality impure grain of bean varieties from farmers makes the bean grain uncompetitive and fetches low prices in the market
What is it? (TIMP description)	Clean good quality bean grain is required by supermarkets and processing factories. Farmers or traders to do the following activities to the bean grain: sorting, cleaning and packaging for supermarkets, export, institutional buyers (schools, hospitals, disciplined forces) and processing factories
Justification	In recent past, there has been moves to make the bean value chain into a viable business oriented enterprise. There is demand by supermarkets, disciplined forces schools and export companies for good quality dry bean grain as per set standards.

Source. David Karanja

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processor and consumers
Approaches used in dissemination	Discussions, Demos, field days, exhibitions, radio, TV, socialmedia (WhatsApp, Facebook, twitter), internet
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers and stakeholders • Buying in by stakeholders • Inclusion of women and youth groups
Partners/stakeholders for scaling up	County extension staff, NGOs, private sector (seed companies, processors, supermarkets), financial service providers, IT providers, local traders and exporters demand
C: Current situation and future scaling up	
Counties where already promoted. if any	Nyeri, Busia, Kiambu, Nairobi (mainly by traders)
Counties where TIMPs will be upscaled	Nyeri and Laikipia (All bean producing areas in medium and high potential areas and the drought stress regions).
Challenges in development and dissemination	<ul style="list-style-type: none"> • Inefficient market system • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage farmers to use certified seed to reduce on bean off-types • Commercialize the bean grain
	<ul style="list-style-type: none"> • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Quality bean grain is important to the formal market
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> • The policies in place are supportive to market beans
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women may have less access to information, innovation and knowledge on the TIMP. • Women may have limited access to education, training and extension services than men
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in making dry bean packaging both home consumption sale
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to agricultural information, technology and knowledge on the dry bean packaging • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some VMGs such as women in making bean noodles for both home consumption and for sale
E: Case studies/profiles of success stories	

Success stories	
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Requires validation
G: Contacts	
Contacts	<ul style="list-style-type: none"> • Institute Director KALRO Katumani • Institute Director KALRO Kandara • Centre Director KALRO Embu • Institute Director KALRO Kakamega
	•
Lead organization and scientists	KALRO Egerton University David Karanja, Katumani, Prof. Benard Towet,
Partner organizations	County Governments, CIAT/PABRA, EAGC, CGA, KENNAFF, Kenya Seed Company, East Africa Seed Company, Dryland Seed Ltd NGOs, bean processors

Gaps

- Evaluate capacity building trainings to small scale entrepreneur, institutions and communities to promote dry bean grain in consumption hubs in collaboration with development partners
- Evaluate and analyse options for business opportunities for youth, women and VMGS in dry bean grain products
- Conduct business and economic analyses of target markets for the dry bean grain products
- Characterise the various KALRO bean varieties for their suitability for processing into the “Value added Dry Bean Grain” (i.e. which bean variety produces the best product?)
- Nutritional profiling / evaluation of the developed product
- Shelf-life studies of the product
- Research on options for commercializing the product – i.e. linking with industry / off-takers (food processors, hotels, supermarkets, etc.)

2.9.2. TIMP	Pre-cooked Dry Bean Grain Product
Category (i.e. technology, innovation or management practice)	Innovation  <p>Source: David Karanja</p>

A: Description of the technology, innovation or management practice	
Problem addressed	Large quantities of fuel energy required to cook beans and limited diversification of bean products
What is it? (TIMPdescription)	About six bean varieties are suitable for pre-cooking in Kenya. The varieties are grown by farmer groups, aggregated, the grain is sorted and cleaned to required standards. The grain is then taken to the factory where it's cooked and water excluded, packaging and distribution is then undertaken. Two products are being marketed to consumers; the 15 minute cooking bean meal and a chocolate look alike bean snack. The 15 minute cooking bean meal is beans which have been pre-cooked and packed, to reduce the time to cook the product by the final consumer.
Justification	The dry bean grain takes from 1-2 hours to cook. The Government is discouraging use of charcoal and firewood in towns and consumers will not cook beans with expensive fuel (gas and electricity). The pre-cooked bean meal takes only 15minutes to cook while the bean snack may not require energy to prepare and consume through this there is also alternative diversified bean products which enhances consumption of the protein rich legume.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Processors, Schools, consumers, supermarkets, farmers, traders, and institutional consumers
Approaches used in dissemination	Discussions, Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of consumers and stakeholders • Buying in by stakeholders • Inclusion of women and youth groups • Need for KEBS to develop food safety standards for the products
Partners/stakeholders for scaling up and their respective roles	Nutrition working groups, County Governments, NGOs, private sector (processors, supermarkets, hotel industry), financial service providers, IT providers, local traders and exporters
C: Current situation and future scaling up	
Counties where already promoted. if any	Machakos, Makueni, Homabay
Counties where TIMPs will be upscaled	Laikipia and Nyeri especially towns, urban centres and areas where bean production is a challenge (also most areas in Kenya)
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack of processing infrastructure for the products • Inefficient market system • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Sensitize consumers and stakeholders on pre-cooked beans • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders

	<ul style="list-style-type: none"> • Avail appropriate food processing infrastructure
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Quality bean grain is important for pre-cooked bean products
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • The policies in place are supportive to market beans • Standards are essential for penetrating high-end formal markets <input type="checkbox"/>
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated basic cost per kg is KES.
Estimated returns	Estimated returns
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Since women perform most of the cooking activities, the innovation will reduce their cooking work burden • The innovation will reduce women's time spent in fetching firewood. • Women may have less access to information, technology and knowledge on the innovation • Women have limited access to training and extension services
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in pre-cooking the bean for both for home consumption and for sale
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The innovation will reduce the cooking work burden of some VMGs such as women • The innovation will reduce women's time spent in fetching firewood. • VMGs have less access to agricultural information, technology and knowledge on the bean noodles • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some VMGs such as women in pre-cooking the bean for both home consumption and for sale
E: Case studies/profiles of success stories	
Success stories	Groups of farmers in Makueni and Homabay are producing the specific varieties for producing pre-cooked bean products and are linked to the processing factory
Application guidelines for users	Training manual, Brochures, factsheets and flyers
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katamani@kalro.org
Lead organization and	David Karanja, KALRO Katumani, Eliud Birachi –

scientists	CIAT
Partner organizations	County Governments, CIAT/PABRA, Lasting Solutions, Smart Logistics, traders and supermarkets


GAPS

Require Validation

- Evaluate capacity building and trainings to small scale entrepreneur, institutions and communities to promote pre-cooked bean based products in consumption hubs in collaboration with development partners

Require further research

- Conduct business and economic analyses of target markets for the various pre-cooked bean based products
- Nutritional profiling / evaluation of the pre-cooked bean products
- Shelf-life studies for pre-cooked beans
- Research on options for commercializing the products

2.9.3. TIMP Name	
Pre-cooked 100% Bean Flours	
Category (i.e. technology, innovation or management practice)	Innovation  <p>Source: David Karanja</p>
A: Description of the technology, innovation or management practice	
Problems addressed	High malnutrition rates (Protein-Energy Malnutrition, PEM). In most low income and rural areas affecting especially the elderly and children.
What is it? (TIMP description)	This is flour processed from common dry beans. The grain into the factory where it's cooked and water excluded, milled into flour and packaged for sale.
Justification	The bean grain has essential nutritional elements and is often considered the meat of the poor. This group is known to consume products made from flours. Pre-cooked bean flours can be blended with maize or wheat flours to make nutritious meals.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Processors, consumers, supermarkets, farmers, traders, and institutional consumers, county governments, NGOs

Approaches used in dissemination	Discussions, community health rallies, Demos, field days, exhibitions, radio, TV, social media (whatsapp, facebook, twitter), internet
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of consumers and stakeholders • Buying inn by stakeholders • Inclusion of women and youth groups <p>In rural areas, farmer groups can be trained on the food safety kit and processing of bean flour at cottage level. Care needs to be taken during drying of the cooked beans as contamination can occur at this stage</p>
Partners/stakeholders for scaling up and their respective roles	Nutrition working groups, County Governments, NGOs, private sector (processors, supermarkets), financial service providers, IT providers, local traders and exporters
C: Current situation and future scaling up	
Counties where already promoted. if any	Machakos, Makueni
Counties where TIMPs will be upscaled	Laikipia and Nyeri (Bean producing and non-bean producing counties in Kenya)
Challenges in development and dissemination	<ul style="list-style-type: none"> • Inefficient market system • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Sensitize consumers and stakeholders on pre-cooked beans, focusing on the nutritional benefits • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned	<ul style="list-style-type: none"> • Quality bean grain is important for pre-cooked bean products
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • The policies in place are supportive to market and consume beans
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	Increased sales and hence income, enhanced nutrition status from increased consumption of beans
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Since women perform most of the cooking activities, the innovation will reduce their cooking work burden • The innovation will reduce women's time spent in fetching firewood. • Women may have less access to information, technology and knowledge on the innovation • Women have limited access to training and extension services
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in making the pre-cooked flour for both for home consumption and for sale
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The innovation will reduce the cooking work burden of some VMGs such as women • The innovation will reduce women's time spent in fetching firewood. • VMGs have less access to agricultural information, technology and knowledge on the bean noodles

	<ul style="list-style-type: none"> • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some VMGs such as women in making the the pre-cooked flour both home consumption and for sale
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Recipes, factsheets, manuals, extension materials
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO Dr Rhoda Nungu Dr Elizabeth Wanjekeche David Karanja Dr Christine Chege
Partner organizations	County Governments, CIAT/PABRA, Lasting Solutions, Smart Logistics, traders and supermarkets

GAPS

Require Validation


- Evaluate capacity building trainings to small scale entrepreneur, institutions and communities to promote bean flour based products in consumption hubs in collaboration with development partners

Require further research

- Conduct business and economic analyses of target markets for the various bean flours
- Flour conversion ratio (beans to flour conversion ratio)
- Nutritional content of bean flour and the derived value added bean-based products
- Technological and food processing properties of bean flour (water absorption capacity, rheological properties, pasting characteristics, etc.)
- Research on options for commercializing the product – i.e. linking with industry / off-takers (food processors, hotels, supermarkets, etc.)

2.9.4. TIMP Name

Bean noodles

Category (i.e. technology, innovation or management practice)	Innovation 
Source David Karanja	
A: Description of the technology, innovation or management practice	
Problem addressed	Low market returns for common dry beans due to lack of product diversification and fortification.
What is it? (TIMP description)	Bean noodles is a product that is meant to add value to common dry beans and fortify it for iron, zinc and amino acids. Noodles offer product diversification and fortification to meet the large market demand
Justification	In recent past, there has been moves to make the bean value chain into a viable business oriented enterprise due to high demand by supermarkets, disciplined forces schools. However, availability of product diversification has been a challenge. Bean noodles offer product diversification and customer satisfaction through fortification and packaging
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, traders, processor and consumers
Approaches used in dissemination	Discussions, Demos, field days, exhibitions, radio, TV, social media (WhatsApp, Facebook, twitter), internet
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of farmers and stakeholders • Buying in by stakeholders • Inclusion of women and youth groups
Partners/stakeholders for scaling up	Farmers and entrepreneurs
C: Current situation and future scaling up	
Counties where already promoted. if any	Nyeri, Busia, Kiambu, Nairobi and Machakos
Counties where TIMPs will be upscaled	Nyeri and Laikipia (All bean producing areas in medium and high potential areas and the drought stress regions).
Challenges in development and dissemination	<ul style="list-style-type: none"> • Inefficient market system • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage farmers to use certified seed to reduce on bean off-types • Commercialize the bean grain
	<ul style="list-style-type: none"> • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if	<ul style="list-style-type: none"> • Quality bean grain is important noodle manufacturing for better


any	quality products.
Social, environmental, policy and market conditions necessary	<ul style="list-style-type: none"> The policies in place are supportive to market beans
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated basic cost of beans per kg for noodle processing is KES. 220
Estimated returns	Estimated returns after value addition is KES. 280 per kg
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> Women may have less access to information, technology and knowledge on the TIMP. Women may have limited access to education, training and extension services than men
Gender related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for women in making bean noodle both home consumption sale
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs have less access to agricultural information, technology and knowledge on the bean noodles VMGs have limited access to training and extension services. Due to their social status VMGs are often excluded from decision making in development and dissemination activities. There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> Employment opportunities exist for some VMGs such as women in making bean noodles for both home consumption and for sale
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	1. Requires validation
G: Contacts	
Contacts	David Karanja C/O Institute Director KALRO-Katumani Box 340-90100, Machakos Email: kalro.katumani@kalro.org
Lead organization and scientists	KALRO, Egerton University David Karanja, Prof. Benard Towet
Partner organizations	County Governments, CIAT/PABRA, EAGC, CGA, KENNAFF, Kenya Seed Company, East Africa Seed Company, Dryland Seed Ltd NGOs, bean processors

Gaps

- Evaluate capacity building trainings to small scale entrepreneur, institutions and

communities to promote for bean noodles in consumption hubs in collaboration with development partners

- Evaluate and analyse options for business opportunities for youth, women and VMGS in bean noodles
- Conduct business and economic analyses of target markets for the bean noodle products
- Characterise the various KALRO bean varieties for their suitability for processing into the “Value added bean noodles” (i.e. which bean variety produces the best product?)
- Nutritional profiling and promotion of the developed product
- Shelf-life studies of the product

2.9.5. TIMP Name		Dry Bean Recipes -(porridge, samosas, cakes, chapatti, ugali, stews)	
Category (i.e. technology, innovation or management practice)	Innovation		
	 <p>From left: Bean Githeri, Bean samosa & Bean ugali Source: David Karanja</p>		
A: Description of the technology, innovation or management practice			
Problem addressed	There is high malnutrition and poor eating habits among communities in Kenya, Beans although being a good product nutritionally, is normally eaten as a main meal or as a stew.		
What is it? (TIMP description)	These are guidelines on how to prepare various bean products. These are food products that are bean based and are from porridge, samosas, cakes, chapatti, ugali, stews. It also includes ways to cook beans in such a way that problematic issues like gas in the stomach are addressed		
Justification	The bean grain has essential nutritional elements and is often considered the meat of the poor. There are limited ways of use of beans as food. To widen the range of consumption, beans can be combined with other ingredients to make various food products that are appealing to consumers		
B: Assessment of dissemination and scaling up/out approaches			
Users of TIMP	Farmers, hospitals, consumers, hotels and schools		
Approaches used in dissemination	Discussions, Demos, field days, exhibitions, radio, TV, social media (whatsapp, facebook, twitter), internet		
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Capacity building of consumers and stakeholders • Buying in by stakeholders • Inclusion of women and youth groups 		
Partners/stakeholders for scaling up	<ul style="list-style-type: none"> • Nutrition working groups, County Governments, NGOs, private sector (processors, supermarkets, hotels) and ICT providers 		
C: Current situation and future scaling up			

Counties where already promoted. if any	Machakos, Makueni
Counties where TIMPs will be upscaled	Laikipia and Nyeri (Bean producing and non-bean producing counties in Kenya)
Challenges in development and dissemination	<ul style="list-style-type: none"> • Lack or insufficient resources in capacity building • Inadequate information to stakeholders • Weak or non-existent stakeholder innovation platforms
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Sensitize county governments to include these activities in their budgeting cycle • Develop and disseminate information to the various stakeholders • Establish and strengthen stakeholder innovation platforms and identify the platform leaders
Lessons learned in up scaling, if any	<ul style="list-style-type: none"> • Quality bean grain is important for pre-cooked bean products
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Strategies are in place to enhance uptake by various communities and policies are favourable
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	
Estimated returns	
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Since women perform most of the cooking activities, the innovation will reduce their cooking work burden • The innovation will reduce women's time spent in fetching firewood. • Women may have less access to information, technology and knowledge on the innovation • Women have limited access to training and extension services
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for women in making the various bean recipes for both home consumption and for sale • Employment opportunities exist for the other gender categories including men in making the various bean recipes for both for home consumption and for sale
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The innovation will reduce the cooking work burden of some VMGs such as women • The innovation will reduce women's time spent in fetching firewood. • VMGs have less access to agricultural information, technology and knowledge on the bean noodles • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for some VMGs such as women in making the various recipes both home consumption and for sale

E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Recipes, factsheets, food processing manuals
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Require validation
G: Contacts	
Contacts	Centre Director, KALRO Kitale Po Box 450-30200 Kitale. Email: director.fcrl@kalro.org
Lead organization and scientists	KALRO CIAT Dr Elizabeth Wanjekeche Dr. Francis Wayua, Dr Christine Chege
Partner organizations	County Governments, CIAT/PABRA, NGOs, JKUAT

Gaps for further research

- Evaluate capacity building trainings to small scale entrepreneur, institutions and communities to promote bean recipes in consumption hubs in collaboration with development partners
- Conduct business and economic analyses of target markets for the various bean value added products
- Optimising processing procedures for the products
- Characterise the bean varieties for their suitability for processing the various products (Porridge, samosas, cakes, chapatti, ugali, stews)
- Research on options for commercializing the products

2.10 Mechanization in dry bean production

2.10.1 TIMP Name	Power tiller
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of seedbed preparation, in the commercialized Bean commodity. Delayed operation lead to late planting. High cost of manual labour. Poor inconsistent land preparation

What is it? (TIMP description)



Source; Nasirembe, AMRI Katumani 2021

A Power Tiller is a two-wheeled agricultural implement fitted with rotary tillers, disk harrow, mouldboard 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

Power Tiller is applicable in tillage, sowing, spraying chemicals, and irrigating, harvesting, threshing and transporting crops. A power Tiller is ideal where land size is small. Farm sizes average less than one hectares which limit manoeuvrability of conventional tractors. Manual Labour is inconsistent, costly and slow.

B: Assessment of dissemination and scaling up/out approaches


Users of TIMP	Bean farmers, researchers. Universities, Extension service providers
Approaches used in dissemination	Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Timeliness, efficiency, low cost, versatility
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, Universities for information • Machinery fabricators • NGO supporting farmers for dissemination

C: Current situation and future scaling up

Counties where already promoted if any	Machakos, Makena
Counties where TIMP will be up scaled	Nakuru, Bungoma, Trans Nzoia, Busia, Baringo
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of the machines • High initial cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Fabrication of affordable bean production machines
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Attracts more men to the farm and releases labour
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in the community. • Inclusion of all gender groups in research, and validation.

	<ul style="list-style-type: none"> • Favourable Policy on cost of agricultural mechanization and their spare parts.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the power tiller. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce the drudgery of work of the various gender categories such as women. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as

	the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.2 TIMP Name	Wheeled Tractor
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in the commercialized Bean commodity • Delayed operation lead to late planting • High cost of manual labour • Poor inconsistent land preparation
What is it? (TIMP description)	<p>A tractor is an engineering vehicle specifically designed to deliver a high tractive effort (or torque) at slow speeds, for the purposes of hauling a trailer or machinery such as that used in agriculture. Most commonly, the term is used to describe a farm vehicle that provides the power and traction to mechanize agricultural tasks, especially (and originally) tillage, trailer towing, planting, weeding, ridging, planting, spraying, harvesting, ground grading and much more agricultural functions. Agricultural implements may be towed behind, mounted behind or in front of the tractor and the tractor may also provide a source of power if the implement is mechanized. It is therefore fitted with</p>
	

Source; Nasirembe, ATDC Siakago 2021	various equipment at alternate times for easing farm operations
Justification	A Tractors is an essential necessity of farming as it provides machine power for performing farm applications. In addition to routine farm activities, it is efficient, timely and consistent, releases labour and reduces cost.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Bean farmers, Researchers, Universities, Extension Service providers
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • 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	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Embu
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of tractors • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish a 4-wheeled innovation platform • Acquisition of the machines • Lack of facilitation to demonstration site • Build financial capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	Mechanization in agriculture increases production
Social, environmental, policy and market conditions	<ul style="list-style-type: none"> • Chances of successful up-scaling are higher

necessary for development and up scaling	<p>when diverse value chain stakeholders collaborate in an innovation platform</p> <ul style="list-style-type: none"> • Partnership is important in technology dissemination and adoption • Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas • Provides low cost farm operations
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	1.780,000
Estimated returns	160,000/ month gross income across a busy season
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of this labor intensive implement will reduce the work burden of men and women who perform the task of ploughing • Women perform most of the crop production activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the wheeled factor. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and

	<p>extension services.</p> <ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Requires validation
G: Contacts	
Contacts	The Institute Director, KALRO AMRI -Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasireembe W,
Partner organizations	Local Fabricators

2.10.3 TIMP Name	Mouldboard plough
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in the commercialized Bean commodity • Delayed operation lead to late planting • High cost of manual labour • Poor inconsistent land preparation
What is it? (TIMP description)	Mouldboard plough is an agricultural implement and is generally considered to be an important tillage implement. Mouldboard ploughs are available for power tiller and



Source; CAPTAIN TRACTORS PVT. Ltd

tractor operation. a mouldboard plough does four jobs namely a) cutting the furrow slice, b) lifting the furrow slice. c) inverting the furrow slice and d) pulverizing the furrow slice. Ploughing accounts for more traction energy than any other field operation.

Justification	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.
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B: Assessment of dissemination and scaling up/out approaches

Users of TIMP	Bean farmers, Researchers, Universities, Extension Service providers
Approaches used in dissemination	<ul style="list-style-type: none"> Farmer field and business Schools (FFBS) Agricultural Innovation Platforms (AIP) Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	Timeliness, efficiency, low cost, multiple usage
Partners/stakeholders for scaling up and their roles	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination


C: Current situation and future scaling up

Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> Lack of finger millet innovation platforms to facilitate interaction of farmers with relevant stakeholders Lack of tractors Lack of facilitation to demonstration site High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Fabrication of affordable Bean production machines Establish a plough ploughs innovation platform

	<ul style="list-style-type: none"> • Acquisition of the machines • Lack of facilitation to demonstration site • Build financial capacity through efficient agricultural production to afford the cost chins
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"> • Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	250,000
Estimated returns	22,800/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of this labor intensive implement will reduce the work burden of men and women who perform the task of ploughing • Women and youth have limited access credit to purchase the mouldboard Plough. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of some VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often

	<p>excluded from decision making in development and dissemination activities.</p> <ul style="list-style-type: none"> • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2- requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators


2.10.4 TIMP Name	Disc harrow
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in a commercialized Dry bean commodity • Difficult to break clods manually • Delayed operation lead to late planting • Low acreage because of lack of manual labour • High cost of manual labour

<p>What is it? (TIMP description)</p>  <p>Source; https://fonts.gstatic.com/s/i/productlogos/lens_camera/v1/192px.svg</p>	<p>A harrow, farm implement used to pulverize soil, break up crop residues, uproot weeds and cover seed. It is a farm implement used for surface tillage. It is used after ploughing for breaking up and smoothing out the surface of the soil. The purpose of harrowing is to break up clods and to provide a soil structure, called tilth, that is suitable for planting seeds. Coarser harrowing may also be used to remove weeds and to cover seed after sowing.</p>
<p>Justification</p>	<ul style="list-style-type: none"> • Creating of a crumbly layer for planting manually is tedious. • It is not possible to manually protect the soil surface from rapid drying. • Improving both the air and water penetrability into soil can be too expensive if manually undertaken. • Manual operation will reduce microbiological processes in the soil • Manual land harrowing Improves nutrient availability to plants.
<p>B: Assessment of dissemination and scaling up/out approaches</p>	
<p>Users of TIMP</p>	<p>Bean farmers and researchers</p>
<p>Approaches used in dissemination</p>	<ul style="list-style-type: none"> • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Field Demonstrations and training, • Agricultural shows (ASK) and other exhibitions
<p>Critical/essential factors for successful promotion</p>	<ul style="list-style-type: none"> • Applied and adaptive Research to test, validate and release improved cabbage varieties • A platform for interaction of Dry bean value chain stakeholders • Multiple usage, timeliness, efficiency and low cost
<p>Partners/stakeholders for scaling up and their roles</p>	<p>KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination</p>

C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of Dry bean innovation platforms to facilitate interaction of farmers with relevant stakeholders • Lack of machines • Lack of facilitation to demonstration site • High initial cost for small-scale machines
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish Dry bean innovation platforms • Acquisition of the machines • Lack of facilitation to demonstration site • Build capacity through efficient agricultural production to afford the cost
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Mechanization in agriculture increases production • Mechanization releases labour to alternative requirement areas <p>Provides low cost farm operations</p>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in agricultural production • Include all gender groups in research, and validation. • Appropriate policy formulation of agricultural mechanization
Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	25,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men perform the land preparation activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the disk harrow implement.

	<ul style="list-style-type: none"> • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce labor burden of some VMGs who usually perform the task. • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2- requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org


	Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.5 TIMP Name	Spring Tine Harrow
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in the commercialized Bean commodity • Delayed operation lead to late planting • High cost of manual labour • Poor inconsistent land preparation
What is it? (TIMP description) Source;;South Peak Rentals LLC 	It is a harrow with peg shaped teeth of diamond cross section to a rectangular frame. It is used to <ul style="list-style-type: none"> • Break clod • Stir soil • Uproot weeds • Level ground • Break soil • Cover seeds.
Justification	The cost of labour, inefficiencies breaking clods, ability of stirring soil, uprooting weeds, ease of levelling ground, breaking soil
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, seed producers, contractors, machine operators.
Approaches used in dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building, stakeholder networks and effective extension services.
Partners/stakeholders for scaling up and their roles	KALRO, Universities for information

	Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	Non
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of the machines • High initial cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Fabrication of affordable Bean production machines
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"> • Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	180,000
Estimated returns	20,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Spring tine harrow will reduce the labour burden of the various gender categories that perform the task of harrowing such as women and men. • Women and youth have limited access credit to purchase the disk harrow implement. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for them to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of some VMGs such as women.


	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.6 TIMP Name	Seed Planter
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Drudgery • inefficient input placement • Delayed task accomplishment • High cost of manual labour • Poor inconsistent seed rate
What is it? (TIMP description)	It is a seed dispenser on the farm that places

 <p>Source; Corn Seed Maize Bean Seeder Planter ... alibaba.com</p>	<p>seed and fertilizer at predetermined quantities. It is commonly used in small grains. It is propelled by a tractor. It is an attachment of a tractor of size 45-65hp than can economically tow the implement on a well prepared seedbed using a plough, disk harrow and tine harrow</p>
<p>Justification</p>	<p>The cost of labour, inefficiencies in seed placement, releases labour for other activities and tremendously reduces time taken on a unit area being planted resulting into increased productivity.</p>
<p>Counties where variety was tested and promoted</p>	<p>Non</p>
<p>Counties where the TIMP will be promoted</p>	<p>Machakos Tharaka Nithi, Kitui, Makueni</p>
<p>B: Assessment of dissemination and scaling up/out approaches</p>	
<p>Users of TIMP</p>	<p>Bean farmers, Universities, researchers, extension agencies, seed producers, contractors, machine operators.</p>
<p>Approaches 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>On-farm experimentation and larger plot effect demonstrations.</p>
<p>Partners/stakeholders for scaling up and their roles</p>	<p>Participatory implementation, stakeholder capacity building, functioning, stakeholder networks and effective extension services.</p>
<p>C: Current situation and future scaling up</p>	
<p>Counties where already promoted if any</p>	<p>Non</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"> • Machine availability • Land size • Calibration of planter • Trained plant operators
<p>Suggestions for addressing the challenges</p>	<ul style="list-style-type: none"> • Contracting approach/sharing • Use of smaller equipment • Train on Calibration of planter

	<ul style="list-style-type: none"> • Train plant operators
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	380,000
Estimated returns	450,000/ month gross income during the planting season
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the planting activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the planter. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the implement. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-	Requires further research


requires validation; 3-requires further research)	
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W
Partner organizations	Local Fabricators

2.10.7 TIMP Name	Weeder
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Drudgery • Efficient seed and fertilizer placement • Delayed task accomplishment • Slow and tedious processes of weeding in the commercialized Bean commodity • Delayed operation lead to late weeding • High cost of manual labour • Poor inconsistent weeding
What is it? (TIMP description) 	Five teeth furrow openers are capable of withstanding tough working conditions at heavy soils. With deep positive penetrations can break up hard soil clods and uproot stubbles to leave the ground perfectly worked. With the spacing adjustments or removable of tine on the main frame can be used for multiple number of applications suitable for dry bean cultivation. It is propelled by a small sized tractor 45-55hp.
Justification	Increased labour cost, releases labour for other farm activities, reduced time spent per unit area, inefficiencies in inability of stirring soil, uprooting and covering weeds, difficulty of breaking up soil. Poor both air and water penetrability when done manually undertaken.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Bean farmers and researchers

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	KALRO, Universities for information Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	-None
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of the machines • High initial cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Fabrication of affordable Bean production machines
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"> • Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
• D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the weeding activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access to credit to purchase the weeder. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase weeder. • VMGs have limited access to training

	<p>and extension services.</p> <ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities. • There is low adoption by VMGs due lack of awareness .
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2- requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.8 TIMP Name	Multi-crop cultivator (Walking)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problems to be addressed	<ul style="list-style-type: none"> • Drudgery • Efficient seed and fertilizer placement • Delayed task accomplishment

<p>What is it? (TIMP description)</p>  <p>Source; You tube, Plowing the field with a mini tractor farmerlife, 2020</p>	<p>Five teeth furrow opener are capable to withstand tough working conditions at heavy soils. With deep positive penetrations can break up hard soil clods and uproot stubbles to leave the ground perfectly worked. With the spacing adjustments or removable of tine on the main frame can be used for multiple number of applications suitable for dry bean cultivation. It is propelled by a small sized tractor 45-55hp.</p>
<p>Justification</p>	<p>Increased labour cost, releases labour for other farm activities, reduced time spent per unit area, inefficiencies in inability of stirring soil, uprooting and covering weeds, difficulty of breaking up soil. Poor both air and water penetrability when done manually undertaken.</p>
<p>B: Assessment of dissemination and scaling up/out approaches</p>	
<p>Users of TIMP</p>	<p>Farmers, Universities, researchers, extension agencies, seed producers, contractors, machine operators.</p>
<p>Approaches used in development and 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>Participatory implementation, stakeholder capacity building, stakeholder networks and effective extension services.</p>
<p>Partners/stakeholders for scaling up and their respective roles.</p>	<p>Public and private Partners (MoALF&I) ICRISAT, FIPs (Farmer Input Promotion), , Farmer Groups, Service provider agencies e.g. micro-finance agencies, banks, agro-vets, processors and manufacturers, aggregators e.g. CARD (Community Action for Rural Development)] and others e.g. NGOs, CBOs, and FBOs</p>
<p>C: Current situation and future scaling up</p>	
<p>Counties where variety was tested and promoted</p>	<p>None</p>
<p>Counties where the TIMP will be promoted</p>	<p>Machakos, Tharaka Nithi Kitui Makueni</p>
<p>Challenges in development and dissemination</p>	<ul style="list-style-type: none"> • Machine availability • Weeder setting

	<ul style="list-style-type: none"> • Trained plant operators • Weeder maintenance artisans
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Contracting approach/sharing • Train plant operators
Lessons learned in up scaling, if any	Nil
Social, environmental, policy and market conditions necessary	Gender inclusiveness in crop research and development; Capacity building of stakeholders; understanding the physical and biotic environment in target ecologies; understanding community culture, preferences, and practices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Per acre production cost KES 1,200/=
Estimated returns	Not yet tried
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the crops activities; therefore, the implement will reduce their drudgery of work. • Women and youth have limited access to credit to purchase the implement. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • The multi-crop cultivator will reduce the labour burden of some of the VMGs such as women and those abled differently. • VMGs have limited access to credit to purchase the implement. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in the development and dissemination activities. • There is low adoption by VMGs due lack of awareness .
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.

E: Case studies/profiles of success stories	
Success stories	N/A
Application guidelines for users	Dry bean peat mechanization production leaflets
F: Status of TIMP Readiness 1. Ready for upscaling; 2. Requires validation; 3. Requires further research	Require validation
G: Contacts	
Contacts	Eng. Nasirembe
Lead organization and scientists	KALRO, AMRI Katumani Director.amri@kalro.org
Partner organizations	Egerton University

2.10.9 TIMP Name	Motorized Sprayer
Category (technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	It is a slow and tedious processes of manual spraying Dry bean; Dry bean has a high number of pests that invade leaf, stem.
What is it? (TIMP description)	<p>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.</p> <p>Source; Nasirembe, Katumani, 2021</p>
Justification	Pest reduce yields up to 98% and are a major menace in agricultural production. Before Dry bean forms a canopy, broad leafed weeds compete with Dry bean seedling for nutrients and light greatly reducing their yield. Manual sprayers are labour intensive while spraying




Nozzle Guide for Band and Directed Spraying					
	Even Flat Fan	Two Even Flat Fan	Hollow Cone	Full Cone	Disc and Core Cone
Herbicides					
Pre-emerge	Very Good	Good	Very Good	Good	
Post-emerge Contact	Good	Very Good	Very Good		
Post-emerge Systemic	Very Good	Good			
Fungicides					
Contact	Good		Good		Very Good
Systemic	Very Good				Good
Insecticides					
Contact	Very Good	Very Good	Very Good		Very Good
Systemic	Very Good				Good
Growth Regulators	Good			Very Good	

Source; Nasirembe, Katumani, 2021

	<p>labour is too expensive. It has lower pressure reducing its efficiency hence a motorized knapsack comes in handy.</p> <p>A modern motorized knapsack power that pumps four times faster and covers a wide area in a short time than the manual sprayer</p> <p>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.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dry bean Farmers and agribusiness entrepreneurs
Approaches used in dissemination	<ul style="list-style-type: none"> • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Field Demonstrations and training, Agricultural shows (ASK) and other exhibitions
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Applied and adaptive research to test, validate and release improved cabbage varieties • A platform for interaction of Dry bean value chain stakeholders • Use by Farmers
Partners/stakeholders for scaling up and their roles	Machinery fabricators NGO supporting farmers (AGGRA)
C: Current situation and future scaling up	
Counties where already promoted if any	W/Pokot, Bungoma, Busia, Kericho, Bomet
Counties where TIMP will be up scaled	Kericho
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of Dry bean innovation platforms to facilitate interaction of farmers with relevant stakeholders • Relatively high cost for individual small-scale farmer. • Limited awareness of the existence of machine among some farmers.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Establish Dry bean innovation platforms • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and trainings


Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Chances of successful scaling are higher when diverse value chain stakeholders collaborate in an innovation platform • Partnership is important in technology dissemination and adoption and this can be facilitated through innovation platforms • Products from local/indigenous crops attract huge market, yet very little is being done to promote growth
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in the community. Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Motorized sprayer 55,000 KES per unit
Estimated returns	KES 180,000.00/year
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Men perform most of the spraying activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the motorized sprayer. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce men's work burden. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the

	required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat, Dry bean and rice
Application guidelines for users	<ul style="list-style-type: none"> • User manuals and leaflets
F: Status of TIMP readiness (1-ready for upscaling;, 2- requires validation; 3-requires further research)	<ul style="list-style-type: none"> • ready for upscaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI – Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations and contacts	Local Fabricators

2.10.10 TIMP Name	Bean Thresher
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problems to be addressed	<ul style="list-style-type: none"> • Drudgery • Soiled product • Breakage of grain by available threshers • Delayed task accomplishment
What is it? (TIMP description)  Source; Nasirembe, Katumanai, 2022	<ul style="list-style-type: none"> • A bean thresher developed for threshing, separating, and cleaning dry bean • The major components of the machine include threshing, separation and cleaning units. • After being detached, the grains fall through a concave grid into the cleaning unit which consists of blower set to a speed that only blows out chaff and grain is collected on a receptor
Justification	Reduced drudgery, cost of labour, inefficiencies in grain detachment, winnowing, fuel, throughput and output makes it necessary for increased productivity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, extension agencies, seed producers, contractors, machine operators.
Approaches used in development and dissemination	On-farm experimentation and dissemination, field days, shows, farmer to farmer communication, leaflets, larger plot demonstrations.
Critical/essential factors for successful promotion	Participatory implementation, stakeholder capacity building, functioning, stakeholder networks and effective extension services.
Partners/stakeholders for scaling up and their respective roles.	Public and private Partners (MoALF&I) ICRISAT, FIPs (Farmer Input Promotion), , Farmer Groups, Service provider agencies e.g. micro-finance agencies, banks, agro-vets,

	processors and manufacturers, aggregators e.g. CARD (Community Action for Rural Development)] and others e.g. NGOs, CBOs, and FBOs
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos, Embu, Kitui
Counties where the TIMP will be promoted	Machakos, Kitui, Makueni Meru,
Challenges in development and dissemination	<ul style="list-style-type: none"> • Protective clothing • Machine availability • Trained machine operators
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Contracting approach/sharing • Train on machine operation
Lessons learned in up scaling, if any	Size, Portability, discharge height
Social, environmental, policy and market conditions necessary	Gender inclusiveness in Machine research and development; Capacity building of stakeholders; understanding community culture, preferences, and practices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 230,000/=
Estimated returns	KES 3,600/= per hour
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the threshing activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the thresher. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Introduction of this labor intensive implement will reduce women's work burden. • Affirmative action opportunities such as the women and youth enterprise


	fund exists for VMGs to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of VMGs such as women • Some VMGs such as the elderly and those abled differently may not be able to operate the implement. • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories	Request from farmers for thresher
Application guidelines for users	Dry bean mechanization production leaflets
F: Status of TIMP Readiness 1. Ready for upscaling; 2. Requires validation; 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	Eng. Nasirembe
Lead organization and scientists	KALRO, AMRI Katumani Director.amri@kalro.org
Partner organizations	Egerton University

2.10.11 TIMP Name	Combine Harvester
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Drudgery • Efficiencies in grain detachment, winnowing, fuel, throughput and output. • Delayed task accomplishment
<p>What is it? (TIMP description)</p>  <p>Source; Node Affiliation: Colorado State University Image uploaded: Thursday, January 24, 2008, by M.A. Brick, Bugwood.org</p>	<ul style="list-style-type: none"> • A combine harvester, is a versatile machine designed to efficiently harvest a variety of grain crops. The name derives from its combining three separate harvesting operations; reaping, threshing, and winnowing into a single process. • The major components of the machine include threshing, separation and cleaning units. • After being beaten, the grains fall through a concave grid into the cleaning unit which consists of blower set to a speed that only blows out chaff and grain is collected on a receptor
Justification	<p>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 and manual Labour is costly and slow.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Bean farmers and researchers
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	KALRO, Universities for information

	Machinery fabricators NGO supporting farmers for dissemination
C: Current situation and future scaling up	
Counties where already promoted if any	-
Counties where TIMP will be up scaled	Baringo, Busia, Isiolo, Kericho, Kisumu, Laikipia, Wajir, Siaya
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of the machines • High initial cost for small-scale farmer when fabricated.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Fabrication of affordable Bean production machines
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"> • Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	180,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the harvesting activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the harvesting machine. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of VMGs such as the elderly and those abled differently. • VMGs have limited access to credit to purchase the farm implements.


	<ul style="list-style-type: none"> • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.12 TIMP Name	Solar Dryer
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of airing crops to reduce moisture content to storage levels, in the commercialized dry bean commodity. The process ties up labour and increases postharvest losses. A solar drying system also called as Solar Dehydrator, particularly for agro-products and marine products, is now extensively used in developing countries

	<p>where labour costs are low and cost of fossil fuel energy is very high. To minimize use of oil or gas, biomass can be used for heating during rainy season and night times. Solar Dryer Price is justified completely.</p>
<p>What is it? (TIMP description)</p>  <p>Source; Solar ATDC Kenya</p> <p>Nasirembe, Dryer at Ruiru,</p>	<p>This sun drying using direct sunlight and open air harnessing power of the sun as solar heat has been used for food preservation of agricultural commodities and products since early stages of mankind in best ways The sun is the central energy producer of our solar system.</p> <p>The solar radiation intensity outside the atmosphere is on average 1,360 W/m² (solar constant). When the solar radiation penetrates through the atmosphere some of the radiation is lost so that on a clear sky sunny day in between 800 to 1000 W/m² (global radiation) can be obtained on the ground harnessed using a solar dryer tent fitted with drying trays on which dry bean is placed for drying. The tent is a converted green house that is affordable and effective.</p>
<p>Justification</p>	<ul style="list-style-type: none"> • High Drying labour expense • There are losses due to transportation • The crop will be soiled • There is loss quality due to bird, chicken, dogs etc. damage • There is a danger of being rained on • Soil and other debris contamination- • Poor drying uniformity
<p>B: Assessment of dissemination and scaling up/out approaches</p>	
<p>Users of TIMP</p>	<p>Bean 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>Timeliness, efficiency, cheap cost, multiple usage</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>C: Current situation and future scaling up</p>	
<p>Counties where already promoted if any</p>	<p>Non</p>
<p>Counties where TIMP will be up scaled</p>	<p>Machakos</p>

Challenges in dissemination	<ul style="list-style-type: none"> • Lack of the innovative dryers • High cost for small-scale farmer dryer when fabricated.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Fabrication of affordable dry bean production dryers
Lessons learned in up scaling if any	Equipment and machines in agriculture increases production
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on mechanization importance in the community. • Include all gender groups in research, and validation. • Favourable Policy on cost of agricultural mechanization
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	220,000
Estimated returns	50,000/ month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<p>Women perform most of the crop's drying activities therefore the implement will reduce their drudgery of work.</p> <p>Women and youth have limited access credit to purchase the harvesting machine.</p> <p>Women have limited access to education, training and extension services than men.</p> <p>Women have less access to agricultural information, technology and knowledge.</p>
Gender related opportunities	<p>Employment opportunities exist for youth males and males in operating the implement.</p> <p>Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.</p>
VMG issues and concerns in development, dissemination, adoption and scaling up	<p>Introduction of the labor intensive implement will reduce the labor burden of VMGs such as women and those abled differently.</p> <p>VMGs have limited access to credit to purchase the farm implements.</p> <p>VMGs have limited access to training and extension services.</p> <p>Due to their social status VMGs are often excluded from decision making in development and dissemination activities.</p> <p>There is low adoption by VMGs due lack of awareness.</p>
VMG related opportunities	<p>Opportunities exist for unemployed youth males in operating the implement.</p> <p>Affirmative action opportunities such as the women and youth enterprise fund exists for</p>

	VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.13 TIMP Name	Size Sorter
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Slow and tedious processes of Manual grading of Dry Bean. It takes a long time before sorting one kilogram of the grain. Poor grading will arise from inconsistency and inefficiency,
What is it? (TIMP description) 	It is an electric powered machine that has two sieves arranged in a descending order to grade two grades and lintel debris. It is fitted with a hopper as a receptor, rotary wheel, sieves and three outlets. The hopper dispenses raw grain on to a sieve that shakes in a reciprocating motion where the larger grains are retained and exit through outlet the first outlet, the one a size smaller come off through the second outlet and debris comes out through the third outlet It is an intermediate technology machine appropriate for Small Holder Farmers, It is designed to size grading for dry bean, etc.
Source Rainbow Machinery Grain Screening Grading Machine	Kaifeng Co., Ltd Sieve
Justification	To make dry bean sorting faster, less tedious and more efficient, attract the youth to

	agribusiness through operation of the machines. Hand sorting is tedious and time consuming and costly.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dry Bean 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
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"> • Relatively High cost for individual small-scale farmer. • Limited awareness of the existence of machine by the farming community.
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage group/cooperative ownership • Launch and awareness campaign through demonstrations and
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • trainings
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Products from local/indigenous crops attract huge market, yet very • little is being done to promote growth of local industry
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	280,000
Estimated returns	125,000 purchase price
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women perform most of the crop's sorting activities therefore the implement will reduce their drudgery of work. • Women and youth have limited access credit to purchase the harvesting machine. • Women have limited access to education, training and extension services than men. • Women have less access to agricultural information, technology and knowledge.

Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Introduction of the labor intensive implement will reduce the labor burden of VMGs such as women who perform most of the crop's sorting activities • VMGs have limited access to credit to purchase the farm implements. • VMGs have limited access to training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	It has reduced labour for farmers in Tharaka Nithi, Kitui, and Kisumu for Dry Bean contracted farmers
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Ready for up-scaling
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.10.14 TIMP Name	Packager
Category (i.e. technology, innovation or management)	Technology

practice)	
A: Description of the technology, innovation or management practice	
Problem to be addressed	<ul style="list-style-type: none"> • Slow and tedious processes of seedbed preparation, in the commercialized Bean commodity • Delayed operation lead to late planting • High cost of manual labour • Poor inconsistent land preparation
<p>What is it? (TIMP description)</p>  <p><i>Figure 1: Source Global Sources Hong Kong Show 2022</i></p>	<p>New controller with high precision, working stable can display the total weight, number of package, easy operation. The adaptive software, having the function of automatic control parameters setting, automatic drop revising, over-weight warning and automatic diagnosis.</p> <p>Products using importer sensor, pneumatic actuator, easy maintenance and non-pollution. Wide packing range, high precision, it can match well with conveyor and sewing machine. The main material body is carbon steel, with painted plastic and material contact part is stainless steel, corrosion resistance, long service life.</p> <p>Communication interface can be offered on need, realization of data communication with PC. It is suitable for the quantitative packaging of granules in food, grain, fodder, sugar making and chemical industry etc. Belt conveyor can adjust higher by hand or motor.</p>
Justification	<p>Manual weighing of beans is a labour intensive and imprecise activity that require a large number of labour force for lifting and transporting the weighed quantity to a desired destination.</p> <p>Manual weighing subjects the product to contamination and the workers also get into frequent contact with agricultural chemicals that are hazardous.</p> <p>Manual sealing of the bag spends more time and sealing material which is a function of individual technical capacity compounded by natural tendencies an art that varies from person to person.</p>
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dry bean aggregators, seed factories, cooperatives and dry bean handlers

Approaches used in dissemination	<ul style="list-style-type: none"> • Pamphlets and training manuals • Stakeholders visits to factories installed with similar machines • Encourage hygienic packaging
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Premium value to machine packed dry bean product • Contracting dry bean farmers and involve farmers • Hold stakeholders meetings regularly
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • KALRO, Universities for information • Machinery dealers • Farmer Co-operatives • Farmer Societies
C: Current situation and future scaling up	
Counties where already promoted if any	Machakos
Counties where TIMP will be up scaled	Kitui, Makueni
Challenges in dissemination	<ul style="list-style-type: none"> • Lack of the machines • Lack of trained technical personnel to operate • High initial cost for small-scale farmer • Awareness for the machine existence
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Encourage dealers to offer the machine on credit • Encourage a curriculum to include dry bean handling at TVET level • State the importance of automating dry bean packaging to stakeholders • Organize peer visits
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Non
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> • Creation of awareness on automating bagging importance in the community • Include all gender groups in research, and validation. • Good Policy on cost of agricultural mechanization
• D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	14,000,000.00
Estimated returns	380,000/= month gross income
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Women and youth have limited access credit to purchase the harvesting machine. • Women have limited access to education, training and extension services than men.

	<ul style="list-style-type: none"> • Women have less access to agricultural information, technology and knowledge.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunities exist for youth males and males in operating the implement.
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have limited access to credit to purchase the farm implements. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by VMGs due lack of awareness.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for unemployed youth males in operating the implement. • Affirmative action opportunities such as the women and youth enterprise fund exists for VMGs to access the required credit.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Mechanization has enabled increased production in other crops such as maize, wheat and rice
Application guidelines for users	<ul style="list-style-type: none"> • Demonstrations and training • User manuals
F: Status of TIMP readiness (1-ready for upscaling;, 2-requires validation; 3-requires further research)	Requires further research
G: Contacts	
Contacts	The Institute Director, KALRO AMRI - Katumani; P.O. Box 340. Machakos Email: cd.katumani@kalro.org Phone: 0711369535
Lead organization and scientists	KALRO, Egerton University Nasirembe W,
Partner organizations	Local Fabricators

2.11 Dry beans farming business and marketing

2.11.1 TIMP name	Transformative Model of production of Dry beans
Category (i.e. technology, innovation or management)	Management practice

practice)	
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beans productivity due to farmers' limited transformation from subsistence-oriented production to commercial-oriented production. Farmers remain at low productivity if there is lack of efforts to shift to the commercial level
What is it? (TIMP description)	The transformative model builds resiliency of farmers of dry beans to focus on market orientation. The transformation model aims at a shift from subsistence to semi-commercial to fully commercial. At the subsistence level, farmers use traditional inputs and the outputs consumed at home. At the semi-commercial level, farmers use both traditional and improved inputs while the output is consumed at home and some get into the markets. At fully commercial, inputs are accessed from the markets and outputs solely for the markets.
Justification	Transformative model ensures increase in productivity due to the surplus demand. Without transformation of dry beans production, the crop will remain subsistence and commercialization will not be attainable, leading to the decline in production and income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Small scale farmers • Small-scale processors • Dry bean exporters • Food processors • Local traders • Consumers • Input markets due to demand in improved markets
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToT • Field days • Exhibitions • Agricultural shows • Mobile phone text initiative • Farmer to farmer • Mass media • Trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of high yielding seeds • Availability of markets • Acceptability of dry beans in the framing systems • Transformative ability of farmers • Favourable policy for trade in green gram
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • MoALFI: Mobilize, train and exhibit the products • NGOs / CBOs: -Mobilize, train and exhibit the products • Cooperatives: Register and train youth/women groups and give loans • KEBS: certification

	<ul style="list-style-type: none"> Processors: To process high quality dry beans products Supermarkets to accept and stock product for sale Consumers: Acceptability Marketers: Moving dry beans products from processors to consumers
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMP will be Upscaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> Awareness: Limited awareness of the economic potential by farmers and consumers Stakeholder linkages: Stakeholders for enhancing transformation High intensity of dry beans management; both in the field and post-harvest
Suggestions for addressing the challenges	<ul style="list-style-type: none"> Awareness creation about the potential of dry beans production to farmers, consumers and other value chain actors Information dissemination – postharvest handling, value addition, and nutritional attributes of the product Scaling up participation of end-user in technology development such as demonstrations and training activities Promote dry beans production all year round
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> Resistance of farmers in growing green gram Subsistence levels of dry beans production Variability in dry beans demand Fluctuations in prices
Social, environmental, policy and market conditions necessary) for development and upscaling	<ul style="list-style-type: none"> Farmers' perceptions Increase in drought frequency Supportive policy in place Organized markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22,357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> Women are widely discriminated in rural producer organizations that are linked to markets. Women have limited access to lucrative markets than men.
Gender related opportunities	<ul style="list-style-type: none"> Men and youth stand to benefit with higher profit margins through collective bargaining during marketing.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> VMGs are widely discriminated in rural producer organizations that are linked to markets.

VMG related opportunities	<ul style="list-style-type: none"> • VMGs stand to benefit with higher profit margins through collective bargaining and marketing. • Opportunities exist for unemployed youth in production and marketing through ICT.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Dry beansrevolution in Kitui County
Application guidelines for users	<ul style="list-style-type: none"> • Factsheets • Dry beansproduction guidelines
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
G: Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- 1 Efficiency evaluation of the farmer-market linking models
- 2 Equity distribution among the producers
- 3 Productivity levels among the smallholder farmers due to transformation
- 4 Farmers access to production inputs

2.11.2 TIMP name	Building a Business Plan for Dry beansproduction
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beansproductivity due to unplanned and traditional production, leading to lack of production targets, losses and market failure
What is it? (TIMP description)	A dry beansbusiness plan serves as an internal management and organizing tool, used to communicate outside the business, or both. The document contains the elements of marketing strategy, marketing costs, income streams and financial requirements
Justification	With a business plan in hand, dry beansfarmers and rural entrepreneurs will be able to take that first step toward the creation of a successful and sustainable business. The plan enables farmers to control costs, develop marketing strategies and build plans for the production to meet market demand
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	<ul style="list-style-type: none"> • Small scale farmers • Small-scale processors • Food processors • Local grain traders • Grain exporters
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToT • Farmers' groups • Farmers' Trainings
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of dry beansgrains • Availability of farmers' groups • Accessed markets • Available technologies for increasing productivity
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • MoALFI: Mobilize, train and exhibit the products • NGOs / CBOs: -Mobilize, train and exhibit the products • Cooperatives: Register and train youth/women groups and give loans • KEBS: certification • Processors: To process high quality dry beansproducts • Supermarkets to accept and stock product for sale • Consumers: Acceptability • Marketers: Moving dry beansproducts from processors to consumers
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMP will be Upscaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> • Literacy levels of farmers • Availability of farm records • Levels of skills in market information collection
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Capacity building in business plan development • Training of ToTs
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary) for development and upscaling	<ul style="list-style-type: none"> • Existence of farmers' groups • Suitable environment for dry beansproduction • Supportive policy in place • Improved access to markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination,	<ul style="list-style-type: none"> • High illiteracy levels of women leading to lack of record keeping

adoption and scaling	and poor record keeping.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for the learned youths to come up with good business plans for themselves and other farmers at a cost
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Some of the VMGs are illiterate hence cannot keep good records.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for the learned youths to come up with good business plans for themselves and other farmers at a cost
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> • Factsheets • Business plan guidelines
F: Status of TIMP readiness (1-ready for upscaling; 2- requires validation; 3-requires further research)	Requires validation
G: Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

2.11.3. TIMP name	Collective marketing
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity leading to low production due to small-scale production and marketing of dry beans products. Also market inaccessibility due to individual farmer marketing, leading to low market power
What is it? (TIMP description)	Collective marketing is marketing as a group where farmers establish an entity to create market links. It involves formation of a group of farmers with an objective of reducing market inaccessibility. Collective marketing is carried through Producer Organizations' (POs) is an institutional vehicle for promoting agricultural production by helping farmers solve common problems in relation to production inputs, credit, technical knowledge and marketing of the produce
Justification	Due to small-scale farming of green gram, marketing as a group would enable farmers to gain from economies of scale. The advantages of

	collective marketing are bigger volumes, uniform quality, reliable sellers, reliable buyers, continuous supply, higher price and organization. The smallholder farmers of dry beans do marketing individually. Due to that, there is lack of economic scale and the prices offered are low. The formation of producer organizations assists small-scale farmers in aggregating the dry beans produce to form a large scale and gain bargaining power for higher prices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Small scale farmers • Dry beans grain traders
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToT • Mobile phone text initiative • Farmer to farmer • Mass media • Trainings • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Willing producers • Availability of quality standards and assured markets • Favorable policy to promote formation of collective marketing
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • MoALFI: Mobilization and training • NGOs / CBOs: -Mobilization and training • Cooperatives: Registration and training
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMP will be Upscaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> • Formation of marketing groups • Awareness: Limited awareness on the collective marketing • Formation of the governing institutions • Distribution of incentives • High costs of group operations • Group dynamics
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Awareness on the importance of collective marketing • Training of group dynamics • Information dissemination – postharvest handling, value addition, and nutritional attributes of the product
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Collective marketing increases income for the individual farmers • Collective marketing links farmers to buyers
Social, environmental, policy and market conditions necessary) for development and upscaling	<ul style="list-style-type: none"> • Farmers with common interests in dry beans production and marketing • Suitable environment for the dry beans production • Supportive policy in place • Ability to meet the required market quality standards
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women are widely discriminated in rural producer organizations • Women also have limited participation and influence in rural producer organizations • Socio-cultural norms may limit women's participation and leadership in groups • Women's double and triple roles means they may not have time to participate • Limited access to assets, resources and services, required to join producer groups • Strict rules of entry and requirements of producers' organizations may limit women participation
Gender related opportunities	<ul style="list-style-type: none"> • Men and youth stand to benefit with higher profit margins through collective bargaining during marketing
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs are widely discriminated in rural producer organizations • VMGs also have limited participation and influence in rural producer organizations • Limited access to assets, resources and services, required to join producer groups
VMG related opportunities	<ul style="list-style-type: none"> • VMGs stand to benefit with higher profit margins through collective bargaining and marketing • Opportunities exist for unemployed youth in production and marketing through ICT
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	<ul style="list-style-type: none"> • Collective marketing manual • Agro-enterprise development guidelines
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
G: Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- Profitable opportunities
- Performance of marketing as a group

2.11.4 TIMP name	Contracted dry beans production model
Category (i.e. technology, innovation or management practice)	Requires validation
A: Description of the technology, innovation or management practice	
Problem addressed	Low productivity due to market failure in dry beans production, leading to low income and poor quality
What is it? (TIMP description)	Contract farming involves investment by the private companies, extending lines of credit to producers in the form of farming inputs and technical assistance. Under contract farming terms, contractors commit themselves to buy the entire product at an agreed price. On the other hand, producers avail desired produce for sale.
Justification	Without contract farming smallholder farmers realize low prices for their produce. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. In essence, contract farming commits the farmer to produce a certain commodity at a certain time for an agreed price and, in return, the contractor undertakes to buy the commodity, and may provide agricultural extension and other services to producers in order to satisfy production requirements in terms of quality and quantity. The benefits of contract farming to farmers are market access, increased incomes, reduction in the risk of price fluctuations, credit and financial intermediation, timely provision of inputs, monitoring and labour incentives, reduction of production risk, introduction of higher-value crops, improved collective bargaining, household spill-over benefits and improved access to extension. A written contract farming is recommended.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Small scale farmers • Contractors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • ToT • Field days • Exhibitions • Mobile phone text initiative • Farmer to farmer • Mass media • Trainings

	<ul style="list-style-type: none"> • Promotional materials (posters/brochures/leaflets)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of contractors • Willing producers • Availability of quality standards and assured markets • Favorable policy to promote contract farming
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • MoALFI: Mobilize, train and exhibit the products • NGOs / CBOs: -Mobilize, train and exhibit the products • Cooperatives: Register and train youth/women groups and give loans • KEBS: certification • Contractors
C: Current situation and future scaling up	
Counties where already promoted, if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMP will be Upscaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in dissemination	<ul style="list-style-type: none"> • Contractors: Availability of contractors • Awareness: Limited awareness on contracted production by the smallholder farmers • Breaking the agreement
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Linking farmers to contractors • Awareness creation about the contracted production • Enforcement of agreement
Lessons learned in upscaling, if any	<ul style="list-style-type: none"> • Contracted farmers earn higher income • Contracted production arrangement enable farmers to access improved inputs • Contracted production has linked markets
Social, environmental, policy and market conditions necessary) for development and upscaling	<ul style="list-style-type: none"> • Acceptability by farmers on contracted production • Supportive policy in place • Ability to meet quality agreed
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women have less access to knowledge and information on contract farming than men. • Women have less access to land for sorghum farming than men.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for youth to enter into contract farming through renting of land for sorghum farming for increased profit margins
VMG issues and concerns in	<ul style="list-style-type: none"> • VMGs have less access to knowledge and information on

development and dissemination, adoption and scaling up	<p>contract farming than men.</p> <ul style="list-style-type: none"> • VMGs have less access to land for farming than men.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for youth to enter into contract farming through renting of land for farming for increased profit margins.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Contracted dry beans production in Tharaka-Nithi
Application guidelines for users	<ul style="list-style-type: none"> • Contract farming factsheets • Agreement guidelines
F: Status of TIMP readiness (1-ready for upscaling; 2-requires validation; 3-requires further research)	Requires validation
G: Contacts	<p>Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294</p>
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

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

2.11.5 TIMP Name	Profitability analysis
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beans productivity due to low farmers' income. The problem of failure of profitability analysis is common among the smallholder farmers. Lack of profitability analysis by farmers in dry beans production, leads to lack of comparison of costs and returns and therefore poor performance of the agro-enterprise.
What is it? (TIMP description)	Profitability analysis involves recording of costs and returns and therefore determination of profit which indicates the performance of the Dry beans agro-enterprise
Justification	Profitability analysis reviews the management success and sustainability of the Dry beans business. It indicates areas of adjustment
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension, NGOs, Researchers.

Approaches to be used in dissemination	<ul style="list-style-type: none"> • Trainings • Factsheets • Manuals • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Record keeping of costs and returns • Ability of farmers to keep records • Applied and adaptive Research to test, validate and release improved Dry beans varieties • A platform for interaction in Dry beans value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – record keeping • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Inability of farmers to keep records • Use of non-costed family labour in Dry beans production
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Inability of farmers to keep records – capacity building • Use of non-costed family labour in Dry beans production – capacity building on how to cost family labour
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Farmers will appreciate profitability analysis in the case of increased returns
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Awareness on record keeping • Environmental conditions – suitable for the increased production of Green gram • Policy conditions – Policy support in costs of inputs and prices of outputs • Market conditions – Higher prices than costs
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • High illiteracy levels of women leading to lack of record keeping and poor record keeping.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for youths to venture in this management practice since majority are literate and can be able to keep good

	farm record
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> Some of the VMGs are illiterate hence cannot keep good records.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities exist for youths to venture in this management practice since majority are literate and can be able to keep good farm record.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- Investigation on strategies to reduce costs of production of Green gram
- Investigation on price increasing strategies

2.11.6 TIMP Name	Market research for Dry beans farmers
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beans productivity due to lack of market information. Failure of the smallholder farmers in gathering information on markets, leads to knowledge asymmetries among the smallholder farmers. Also this leads to poor connectivity of smallholders to distance markets.
What is it? (TIMP description)	Market research gathers information on the product buyers, demand, type required, minimum volume purchased, collective marketing volume, quality, packaging requirements, frequency of delivery, purchase price, means of payment and willing to buy from local farmers
Justification	Without market research the smallholder farmers will continue being

	market disintegrated, leading to low market participation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Traders • Processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Trainings • Factsheets • Manuals • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Can the farmers increase production within their group • How will the farmers increase their production and sales (more technology, more land, more members) • Can the farmers work with other existing groups (available/not available) • Do the farmers need to form new groups • Applied and adaptive Research to test, validate and release improved Dry beans varieties • A platform for interaction in Dry beans value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Members of producer organization • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Targeted markets • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Issues related to the literacy of the marketing groups • Issues related to the mobilization and creation of awareness • Levels of skills of the market research group • Existence of market information
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Issues related to increasing production from existing group – Capacity building of farmers • Issues related to mobilization and awareness creation – sensitization of farmers • Market research skills – Training • Market information – Record keeping
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – are there other farmers who want to join the group • Environmental conditions – would the increase in production come from improved technology, more land, or new members in

	<p>the group</p> <ul style="list-style-type: none"> • Policy conditions – Policies supporting formation and functioning of producer organizations • Market conditions – new markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of women and youth in market research. • Women have less access to market information than men.
Gender related opportunities	<ul style="list-style-type: none"> • Employment opportunity exist for educated youths in conducting market research
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs also have limited participation in market research. • VMGs have less access to market information
VMG related opportunities	<ul style="list-style-type: none"> • Employment opportunity exist for educated youths in conducting market research.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- Processes in scaling up agro-enterprise development approach and production
- Effects of scaling up plan

2.11.7. TIMP Name	Marketing Innovation model
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Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Farmers' failure to apply entrepreneurship while marketing green gram, leading to low prices
What is it? (TIMP description)	Marketing innovation encompasses entrepreneurship where farmers undertake technology modification, finance and business acumen in an effort to transform innovations into economic goods and ultimately profit.
Justification	Marketing innovation involves product diversification. Diversification develops various marketing channels Failure to apply innovation in marketing of green gram, the market outlook will be narrow
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Extension • NGOs • Researchers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Trainings • Factsheets • Manuals • Farmer field and business Schools(FFBS) <ul style="list-style-type: none"> • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Organization of farmers • Availability of innovations • Achievement of profit • Access to finance • Availability of facilitators • Availability of many traders • Production volume and quality • Applied and adaptive Research to test, validate and release improved Dry beansvarieties • A platform for interaction in Dry beansvalue chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Acceptability of innovations • County extension staff - Facilitators • NGOs – Facilitators • Private sector (local traders and exporters) – Buyers • Research institutions – Facilitators
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination	<ul style="list-style-type: none"> • Small-scale farming • Availability of information

	<ul style="list-style-type: none"> • Profitability in Dry beansfarming • Levels of policy support
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Small-scale farming – capacity building to farmers • Availability of information on innovations • Profitable innovations • Strengthening county policy support
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Reduced cost of production, increased profit
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Conflicts with traditional methods • Environmental conditions – sustainability of innovations • Market conditions – Access to inputs such as fertilizer
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women lack entrepreneurial skills and capacity to engage in the marketing innovation model compared with men • Women lack basic reading and numeracy skills so they can run their businesses compared with men • Women may not apply for loans that can be used to start their businesses and increase their profits due to lack of collateral compared with men
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women to venture in entrepreneurship through the women enterprise fund
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs lack basic reading and numeracy skills so they can run their businesses compared with men • VMGs may lack the business acumen to venture in the marketing innovation model compared with men • VMGs may lack the starting capital
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for VMGs to venture in entrepreneurship through affirmative action funds e.g. Uweso fund etc.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Increased income and diversification in investments
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Available innovations are ready for up-scaling

G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

- 1 Sustainability based on market prices
- 2 Innovations for the increased productivity

2.11.8. TIMP Name	
Category (i.e. technology, innovation or management practice)	Internet/mobile marketing
A: Description of the technology, innovation or management practice	
Problem addressed	Limited use of technologies among the smallholder farmers while linking to markets, leading to poor market access and constraints in marketing channels, skills and market information
What is it? (TIMP description)	Internet/mobile marketing refers to the online marketplace that provides buyers and sellers with an avenue to meet and exchange goods and services These can include a variety of online platforms, tools, and content delivery systems
Justification	Internet/mobile marketing is increasingly becoming mandatory for businesses of all types. This high adaptability of internet marketing is an important benefit that businesses can take advantage of to provide their consumers with the best shopping experience. Consumers use a variety of online methods for finding, researching, and eventually making purchasing decisions. Internet marketing reduces costs.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Traders • Processors
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Trainings • Factsheets • Manuals • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Education levels of the farmers and investors in Dry beans production and profitability analysis • Levels of experiences in Dry beans production • Availability of information on Dry beans production and

	<p>marketing</p> <ul style="list-style-type: none"> • Applied and adaptive Research to test, validate and release improved Dry beans varieties • A platform for interaction in Dry beans value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Sellers of Dry beans production • County extension staff - Capacity building • NGOs – Capacity building • Private sector (local traders and exporters) – Buyers of Dry beans • Research institutions – Capacity building
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination	<ul style="list-style-type: none"> • Low digital skills of farmers • Unconsolidated produce for the market • Small-scale farming • Inadequate information to stakeholders on the Dry beans production and marketing and profitability • Internet connectivity • Levels of policy support on internet infrastructure
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Low digital skills of farmers – capacity building • Unconsolidated produce for the market – Delivery of produce to the designated centres • Small-scale farming – capacity building and sensitization to appreciate need for consolidation of produce • Inadequate information to stakeholders on the Dry beans production and marketing and profitability - Developing information hubs • Internet connectivity – Information hubs • Level of policy support – Policy support in internet infrastructure and utilization
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • Requires stakeholders involvement • Remains the best cost effective option for marketing in terms of searching for the market information
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – low levels of adoption of information technology • Environmental conditions – improved internet connectivity • Policy conditions – Policy supporting information hubs • Market conditions – high costs of information technologies
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total

	variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Women have less access to the required tools such as phones and computer than men. • Women are more illiterate and therefore cannot use the ICTs compared with men.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for youth to use the ICT tools since most of them are highly literate and have phones or the computers.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • VMGs have less access to the required tools such as phones and computer than men. • VMGs are more illiterate and therefore cannot use the ICTs compared with men.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for youth to use the ICT tools since most of them are highly literate and have access to phones or computers.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

Gaps for further research

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

2.12 Agricultural Policy Options

2.12.1. TIMP Name	National Agricultural policy strategy framework
Category (i.e. technology, innovation or management practice)	Management practice

A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beans productivity due to lack of centralizing the smallholder farmers' agency and voices in terms of access to inputs and outputs markets. The instruments and the rules to achieve the policy productivity objectives are inappropriate for the smallholder farmers but instead favour the large scale farmers in Kenya.
What is it? (TIMP description)	The National Agricultural policy strategy framework provides instruments and rules for the Counties to develop agriculture in terms of productivity objectives which can assist the smallholder farmers of green gram.
Justification	Without the National Agricultural policy strategy framework, agriculture will remain not integrated with the National development objectives. There will be lack of instruments and the rules to achieve agricultural productivity objectives.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Policy makers • Traders • Processing industries • Extension • NGOs • Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Meetings • Radio • Television • Social media (WhatsApp, Facebook, twitter) • Internet • Farmers' groups • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of specific Green gram-based policies • Applied and adaptive Research to test, validate and release improved Dry beans varieties • A platform for interaction in Dry beans value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Demanding Dry beans policies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Dry beans policies to support production and marketing • Research institutions – Sensitization of stakeholders • Policy makers – Assist in policy making
C: Current situation and future scaling up	
Counties where already promoted	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii,

if any	Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination	<ul style="list-style-type: none"> • Value Chain: Dry beans yields remain low and total domestic production is unable to satisfy demand by manufacturers leading to growing imports of raw materials. • Aggregation: Aggregation models including cooperatives—suffered after the downturn in Dry beans production, wherein many farmers abandoned Dry beans production. These weak organizations provide few services to farmers while providing limited bargaining power. • Financial Incentives: The government provides only limited support to Dry beans producers through subsidized seed, irrigation infrastructure, and research. Meanwhile the bulk of financial incentives, including tax breaks, exemption from import duties, and subsidized electricity, target apparel manufacturers downstream in the value chain, primarily those in Export Processing Zones (EPZs). Some private companies are investing backward in their supply chains to increase farmer production by entering purchase contracts, financing access to inputs, and importing their own hybrid seed. However, none of these efforts are explicitly tied to environmental or CSA standards.
Suggestions for addressing the challenges	<p>Value Chain: Enhance productivity and total production through better seeds, irrigation, and CSA management practices. Develop targeted incentives to encourage stronger engagement of producers by downstream actors.</p> <p>Standards: Existing Dry beans standards and classifications should be redesigned to align with Kenya’s climate-smart agriculture strategy, in coordination with relevant institutions across the sector. Farmer cooperatives should receive public support to promote and enable higher quality production through input access and CSA extension training.</p> <p>Aggregation: Partnerships between farmer cooperatives and Dry beans producers can strengthen market linkages, set guaranteed prices for farmers, and enable access to resilient, high-yielding seeds and other climate-smart inputs.</p> <p>Financial Incentives: Financial incentives can be designed to incentivize private sector, downstream value chain actors to provide services to producers, for example through conditional subsidies. The government may opt to continue its efforts to implement quality-based Dry beans payments, including CSA-criteria, while offering comprehensive service provision for producers through public-private partnerships. Building public-private partnerships is key to filling service gaps for smallholders to improve productivity and disseminate CSA practices.</p>

Lessons learned in up scaling if any	When policy instruments and rules are well implemented, there was an increase in productivity of dry beans in Kitui County
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Acceptability of the policy instruments and rules by the smallholder farmers of green gram • Environmental conditions – sustainability in dry beans production • Policy conditions – Lacking specific Dry beans policy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22,357
Estimated returns	Total returns Ksh. 130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Training factsheets, manuals and power point slides
F: Status of TIMP Readiness (1. Ready for up scaling, 2. Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua

Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers
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Gaps for further research

- 1 Adoption of policies
- 2 Equity distribution among the stakeholders
- 3 Productivity levels among the smallholder farmers of Green gram
- 4 Farmer accessibility to production inputs
- 5 Impact on Dry beansprices

2.12.2. TIMP Name	County Integrated Development Planning
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beansproductivity due to lack of centralization of the smallholder agency and voices while planning agricultural development issues in Kenya
What is it? (TIMP description)	The County Integrated Development Planning is builds a plan for each county in Kenya to be implemented in five years. The planning process is participatory, involving the development stakeholders in the county. It is during this planning period where the issues in Dry beansproduction, marketing and processing are considered. .
Justification	In the Counties where the dry beansvalue chain creates wealth among the smallholder farmers, centralization of the farmers agency and voices need to be considered during the County Integrated Development Planning. Failure to plan for the dry beansproduction would to less optimization of opportunities
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Traders • Processing industries • Extension • NGOs • Research institutions • Policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Meetings • Radio • Television • Social media (WhatsApp, Facebook, twitter), internet • Farmers' groups • Farmer field and business Schools(FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • Availability of agricultural policies and specific Green gram-based policies

	<ul style="list-style-type: none"> • Issues in Dry beansbusiness • Specific policy objective statement • Applied and adaptive Research to test, validate and release improved Dry beansvarieties • A platform for interaction in Dry beansvalue chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – Demanding Dry beanspolicies to support production and marketing • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – Demanding Dry beanspolicies to support production and marketing • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	
Counties where already promoted if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the agricultural policies whether National or County • Poorly established Dry beansvalue chain • Dry beansproduction are specific to agro-ecological zones and not all the Counties in Kenya grow Green gram
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Dry beansvalue chain – strengthening Dry beansvalue chain • Dry beansproduction are specific to agro-ecological zones and not all the Counties in Kenya grow Dry beans– Diversification of Green gram
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • There is increase in dry beansproductivity • There is dry beansbusiness in the Counties which recognize the potential of dry beansduring the County Integrated Development Planning
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Acceptability and contribution during the policy making process • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Dry beanspolicy • Market conditions - Poor market infrastructure

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in the development process of the county integrated plans • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Inadequate representation of VMGs in the development process of the county integrated plans • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for VMGs to participate in the process of developing the county integrated development plans
E: Case studies/profiles of success stories	
Success stories from previous similar projects	<ul style="list-style-type: none"> • Promotion of dry beansthrough County policies
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katumani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- 5 Adoption of policy options
- 6 Equity distribution among the stakeholders
- 7 Productivity levels among the smallholder farmers
- 8 Farmer accessibility to production inputs

2.12.3. TIMP Name	Policy instruments related to Dry beans
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beans productivity due to the existing policy instruments which do not centralize the smallholder farmers' issues in dry beans production. 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. For the dry beans production, some of the policy instruments include subsidy in the inputs and also minimum price for the dry beans outputs.
Justification	Without policy instruments the dry beans productivity will remain low. It is very likely that a particular policy instrument, although designed to have primarily an efficiency, distributive, or stability effect, will also have some impact on the other objectives related to dry beans production
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Traders • Processing industries • Extension • NGOs • Research institutions • Policy makers
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Meetings • Radio • Television • Social media (What's App, Facebook, twitter) • Internet • Farmers' groups • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of policy objectives • Availability of policy instruments • Applied and adaptive Research to test, validate and release improved Dry beans varieties • A platform for interaction in Dry beans value chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – beneficiaries of policy instruments • County extension staff - Sensitization of farmers • NGOs – Sensitization of farmers • Private sector (local traders and exporters) – beneficiaries • Research institutions – Sensitization of stakeholders
C: Current situation and future scaling up	

Counties where already promoted if any	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii, Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on the agricultural policies whether National or County • Poorly established Dry beansvalue chain • Dry beansproduction are specific to agro-ecological zones and not all the Counties in Kenya grow Green gram
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganization and scattered farmers – Formation of producer organizations as an institution • Small-scale farming – Policies for increasing productivity • Inadequate information to stakeholders on the agricultural policies whether National or County – Sensitization of stakeholders • Poorly established Dry beansvalue chain – strengthening Dry beansvalue chain • Dry beansproduction are specific to agro-ecological zones and not all the Counties in Kenya grow Dry beans– Diversification of Green gram
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • In the Counties where dry beansproduction is supported through the policy, there is productivity increase
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Low understanding of policy instruments • Environmental conditions – lack of a comprehensive land use policy • Policy conditions – Lacking specific Dry beanspolicy • Market conditions - Poor market infrastructure
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for adequate youth representation in the policy formulation and validation process if they focus and strategize well.
VMG issues and concerns in	<ul style="list-style-type: none"> • Inadequate representation of VMGs in policy development

development and dissemination, adoption and scaling up	forums at all levels. <ul style="list-style-type: none"> Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	<ul style="list-style-type: none"> Opportunities exist for VMGs participation in all levels of policy formulation since there are policy frameworks to support their participation.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Wealth creation in dry beans production
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katamani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- 9 Validation of policy instruments
- 10 Equity distribution among the stakeholders
- 11 Farmer accessibility to production inputs markets
- 12 Farmers accessibility to output markets

2.12.4. TIMP Name	Policy cycle
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Low dry beans productivity due to the development of agricultural policies not relevant to the problem emergency in dry beans and also without staged follow-up.
What is it? (TIMP description)	The policy process 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. Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. These individual

	steps provide a frame work and antedates any forthcoming issues related to policy development. The policy <i>cycle</i> is usually divided into five stages: agenda setting, formulation, implementation, and evaluation
Justification	Why is a policy cycle an appropriate tool for making policies related to green gram? The policy cycle creates the need for a policy based on the agricultural problem emergence/issues. The policy cycle is an idealized process that explains how policy should be drafted, implemented and assessed. It serves more as an instructive guide for those new to policy than as a practical strictly-defined process, but many organizations aim to complete policies using the policy cycle as an optimal model. Policy cycle is a valuable device for new policy development. It is a tool which divides complex procedures into convenient and manageable steps. ... These steps are flexible enough to incorporate any changes at the time of new policy development and as a part of continuous change once it is implemented.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	<ul style="list-style-type: none"> • Farmers • Traders • Processing industries • Extension • NGOs • Research institutions
Approaches to be used in dissemination	<ul style="list-style-type: none"> • Meetings • Radio • Television • Social media (What's App, Facebook, twitter) • Internet • Farmers' groups • Farmer field and business Schools(FFBS) • Agricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> • Availability of stakeholders • The stages of problem emergence, formulation, implementation and evaluation • Applied and adaptive Research to test, validate and release improved Dry beansvarieties • A platform for interaction in Dry beansvalue chain stakeholders
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> • Farmers – generate issues • County extension staff - capacity building • NGOs – capacity building • Private sector (local traders and exporters) – generate issues • Research institutions – capacity building • Policy makers
C: Current situation and future scaling up	
Counties where already promoted if	Meru, Embu, Nyeri, Nyandarua, Muranga, Embu, Kirinyaga, Kisii,

any	Uasin gishu, Nakuru, Kericho, Bomet,
Counties where TIMPs will be up scaled	Lailipia, Bomet, Thara-Nithi, Nakuru
Challenges in development and dissemination -	<ul style="list-style-type: none"> • Disorganization and scattered farmers • Small-scale farming • Inadequate information to stakeholders on issues • Poorly established Dry beansvalue chain
Suggestions for addressing the challenges	<ul style="list-style-type: none"> • Disorganization and scattered farmers – issues on formation of producer organizations as an institution • Small-scale farming – issues on aggregation • Inadequate information to stakeholders – Sensitization on the roles of each policy cycle stages • Poorly established Dry beansvalue chain – strengthening Dry beansvalue chain
Lessons learned in up scaling if any	<ul style="list-style-type: none"> • None
Social, environmental, policy and market conditions necessary for development and up-scaling	<ul style="list-style-type: none"> • Social conditions – Different issues among the Dry beansproducers • Environmental conditions – environmental issues concerning sustainability in dry beansproduction • Policy conditions – Lacking specific Dry beanspolicy • Market conditions – Market issues
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total variable costs Ksh. 22.357
Estimated returns	Total returns Ksh.130,000 per acre per season (20 bags per acre @ Ksh 6500) without deducting total variable costs. After deducting total variable costs, The gross margin is Ksh 107,643
Gender issues and concerns in development and dissemination, adoption and scaling	<ul style="list-style-type: none"> • Inadequate representation of youth and women in policy development forums at all levels. • Inadequate representation of youth and women in the policy of validation process.
Gender related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation
VMG issues and concerns in development and dissemination, adoption and scaling up	<ul style="list-style-type: none"> • Inadequate representation of VMGs in policy development forums at all levels. • Inadequate representation of VMGs in the policy of validation process.
VMG related opportunities	<ul style="list-style-type: none"> • Opportunities exist for women and youths to participate in the policy cycle since the constitution supports their participation
E: Case studies/profiles of success stories	
Success stories from previous similar	None

projects	
Application guidelines for users	Training factsheets, manuals and power point slides are available
F: Status of TIMP Readiness (1. Ready for up scaling, 2, Requires validation, 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Centre Director, KALRO-Katumani P.O. Box 340-90100 Machakos cd.katamani@kalro.org Phone: 0736333294
Lead organization and scientists	KALRO; David Karanja; John Wambua
Partner organizations	Ministry of Agriculture, Livestock, Fisheries and Irrigation, Farmers

GAPS

Further research

- 13 Analysis of policy model
- 14 Impact on the new policy on Dry beans production and marketing

Annex 1. Common beans varieties released in Kenya

Bush Beans

No	Variety name	Variety code	Year of release	Owner(s)	Maintainer and seed source
1	Mwitmania	GLP X 92	1982	KALRO/Kenya Seed Co	KALRO/Kenya Seed Co
2	Rosecoco	GLP 2	1982	KALRO/Kenya Seed Co	KALRO/Kenya Seed Co
3	Mwezi Moja	GLP1004	1982	KALRO/Kenya Seed Co	KALRO/Kenya Seed Co
4	Canadian Wonder	GLP-24	1982	KALRO/Kenya Seed Co	KALRO/Kenya Seed Co
5	Red haricot	GLP-585	1982	KALRO	KALRO-Kandara
6	New Mwezi Moja	GLP-X 1127	1982	KALRO/Kenya Seed Co	KALRO/Kenya Seed Co
7	Kat/Bean 2	Kat/Bean 2	1987	KALRO	KALRO-Katumani
8	Kat X 16	Kat X 16	1994	KALRO	KALRO-Katumani
9	Kat X56	Kat X56	1995	KALRO	KALRO-Katumani
10	Kat X 69	Kat X 69	1995	KALRO	KALRO-Katumani
11	KK 22	RWR 719	1996	KALRO	KALRO-Kakamega
12	Katheka	Kat/Bean 1	1987	KALRO	KALRO-Katumani
13	KK 8	SCAM-80/15	1997	KALRO	KALRO-Kakamega
14	KK 15	MLB 49/879	1997	KALRO	KALRO-Kakamega
15	Kat-Bean 9	Kat-Bean 9	1998	KALRO	KALRO-Katumani
16	Wairimu Dwarf	Wairimu Dwarf	2008	Kenya Seed Co	Kenya Seed Co
17	New Rose Coco	New Rose Coco	2008	University of Nairobi	University of Nairobi
18	Miezi Mbili	Miezi Mbili	2008	University of Nairobi	University of Nairobi
19	Kenya early	Kenya early	2008	University of Nairobi	University of Nairobi
20	Kenya Red Kidney	Kenya Red Kidney	2008	University of Nairobi	University of Nairobi

21	Super Rose Coco	Super Rose Coco	2008	University of Nairobi	University of Nairobi
22	Kenya Wonder	Kenya Wonder	2008	University of Nairobi	University of Nairobi
23	Kenya Sugar Bean	Kenya Sugar Bean	2008	University of Nairobi	University of Nairobi
24	Kabete Super	Kabete Super	2008	University of Nairobi	University of Nairobi
25	Chelalang	Chelalang	2008	Egerton University	Egerton University
26	Tasha	Tasha	2008	Egerton University	Egerton University
27	Cianku	Cianku	2008	Egerton University	Egerton University
28	Mbigo	Mbigo	2013	KALRO	KALRO-Embu
29	Katram	KAT-RM01	2014	KALRO	KALRO-Katumani
30	Mwende	EMBEAN14	2014	KALRO	KALRO Embu
31	Rosecoco Madini	MN1	2015	University of Nairobi	University of Nairobi
32	Kenya Almasi	MN3	2015	University of Nairobi	University of Nairobi
33	Kenya Cheupe	MN6	2015	University of Nairobi	University of Nairobi
34	Kenya Maua	MN9	2015	University of Nairobi	University of Nairobi
35	KK Rosecoco- 194	KK ROSECOCO- 194	2015	KALRO	KALRO-Kakamega
36	KK Red Bean-16	KK RED BEAN- 16	2015	KALRO	KALRO-Kakamega
37	Nyota	KAD 02	2017	KALRO	KALRO- Katumani
38	Angaza	KMR 11	2017	KALRO	KALRO- Kandara
39	Metameta	KMR 12	2017	KALRO	KALRO- Katumani
40	Faida	KMR13	2017	KALRO	KALRO -Kandara
41	Kenya Mali	KAT-SW-12	2015	KALRO	KALRO-Katumani
42	Tamutamu	KAT-SW-13	2015	KALRO	KALRO-Katumani
43	Kenya Mamboleo	KCB 13-02	2015	University of Nairobi	University of Nairobi

44	Kenya Salama	KCB13-09	2015	University of Nairobi	University of Nairobi
45	KenStar	KCB13-11	2015	University of Nairobi	University of Nairobi
46	KK-Red bean 13	KKRIL05/RED 13	2017	KALRO	KALRO- Kakamega
47	KK- Rosecoco 33	KKRIL05/CAL 33	2017	KALRO	KALRO- Kakamega
48	Kenya Red Kidney	KCB13-04	2018	University of Nairobi	University of Nairobi
49	Kazuri	SIMLAW B9	2021	Simlaw seed Co. Ltd	Simlaw seed Co. Ltd
50	Saitoti	Saitoti	2021	KALRO	KALRO Kitale
51	Tatton Bean	EUB 502	2021	Egerton University	Egerton University
52	Zebra	AGRYB402	2021	Agrosoy Seed Company	Agrosoy Seed Company

Climbing beans

53	Flora	Flora	1996	KALRO	KALRO-Kakamega
54	Mvunikingi	Mvunikingi	1996	KALRO	KALRO-Kakamega
55	Umubano	Umubano	1996	KALRO	KALRO-Kakamega
56	Kenya Safi	MAC 13	2012	KALRO/University of Nairobi	KALRO/University of Nairobi
57	Kenya Tamu	MAC 34	2012	KALRO/University of Nairobi	KALRO/University of Nairobi
58	Kenya mavuno	MAC 64	2012	KALRO/University of Nairobi	KALRO/University of Nairobi



Kenya Climate Smart
Agriculture Project

Kenya Climate Smart Agriculture Project (KCSAP)
P.O. Box 57811-00200, City Square, Nairobi, Kenya

www.kalro.org