



Kenya Climate Smart  
Agriculture Project

# Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Pastures and Fodder Value Chain



Kuria S.G., Mnene W.N., Ogillo B.P., Kubasu D.O., Maweu A.N., Bii J. C., Korir B.K., Kimutai J., Kidake B.K., Njuguna P.M., Wambulwa L.M., Katiku P.N., Ndung'u B.W., Nyambati E.M., Wamuongo J.W. and Ilatsia E.D.

OCTOBER 2022

## **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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P O Box 57811-00200  
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Email: [directorgeneral@kalro.org](mailto:directorgeneral@kalro.org)

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

Compiled by: Kuria S.G., Mnene W.N., Ogillo B.P., Kubasu D.O., Maweu A.N., Bii J.C., Korir B.K., Kimutai J., Kidake B.K., Njuguna P.M., Wambulwa L.M., Katiku P.N., Ndung'u B.W., Nyambati E.M., Wamuongo J.W. and Ilatsia E.D.

**Editors:** Nyabundi K.W., Mukundi K.T., Maina P., Wanyama H.N., Kedemi R.M. and Kuria S.G.

Editing and Publication coordination: Wamuongo J. W. and Lung'aho C.

Design and layout: Nyaola E.

Typesetting: Mogaka I.

## **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 Pastures and Fodders 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 Pastures and Fodders 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 livestock-based value chains are five and include apiculture, indigenous chicken (meat and eggs), dairy (cattle and camel), red meat (cattle, sheep and goats) and aquaculture. Also, there are three cross cutting thematic areas on pastures and fodder, natural resource management, and animal health. 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). 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 Pasture and Fodder 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.

John Nginyangi  
National Project Coordinator  
**Kenya Climate-Smart Agriculture Project**

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## **ABBREVIATIONS AND ACRONYMS**

ASAL	Arid and Semi-Arid Lands
ADF	Acid Detergent Fibre
CBO	Community Based Organization
CGIAR	Consultative Group for International Agricultural Research
CIG	Common Interest Group
CSA	Climate Smart Agriculture
FFS	Farmer Field School
Ha	Hectare
ITK	Indigenous Technical Knowledge
KALRO	Kenya Agricultural and Livestock Research Organization
KAPALIG	Kavatini Pastoralists Livestock Improvement Group
KCSAP	Kenya Climate-Smart Agriculture Project
KEPHIS	Kenya plant and Health Inspectorate
KES	Kenya Shilling
ME	Metabolizable Energy
MJ	Mega Joules
MoALFC	Ministry of Agriculture, Livestock, Fisheries and Cooperatives
NARS	National Agricultural Research Systems
NGO	Non-Governmental organization
PFS	Pastoral Field Schools
TIMP	Technologies, Innovations and Management Practices
TOT	Training of Trainers Manual
VMG	Venerable and Marginalized Groups

## 1.0 DEFINITION OF TERMS AND SUMMARY TABLES

### 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 Pasture and Fodder Value Chain

The inventory process resulted in a total of 15 TIMPs including 2 technologies, 1 innovation and 12 management practices, distributed among 4 sub-themes, as indicated in Table 1.

**Table 1: TIMPS in the Pasture and Fodder Value Chain**

Commodity/VC	Sub-Theme	Technologies	Innovations	Management Practices
Pasture and Fodder	Natural Pasture Improvement	0	1	1
Pasture and Fodder	Pastoral and Agro-pastoral Seed Systems	3	0	2
Pasture and Fodder	Supplementary Feeding of Range Livestock	1	0	4
Pasture and Fodder	Pastoral and Agro-pastoral Information System	0	0	4
Overall Total	16	4	1	11

### 1.3 Summary of Status of TIMPs in Pasture and Fodder Value Chain

The inventory process resulted in a total of 10 TIMPs that are ready for up scaling, one (1) TIMP that require validation and 4 TIMPs that require further research in the sub-themes, as indicated in Table 2.

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

Commodity/VC	Sub-Theme	Ready for up-scaling	Require validation	Further Research
Pasture and Fodder	Natural Pasture Improvement	1	0	0
	Pastoral and Agro-pastoral Seed Systems	2	0	4
	Supplementary Feeding of Range Livestock	4	0	1
	Pastoral and Agro-pastoral Information System	3	1	0
Overall Total		10	1	5

**Table 3: Inventory of Pasture and Fodder TIMPs by Category and Status**

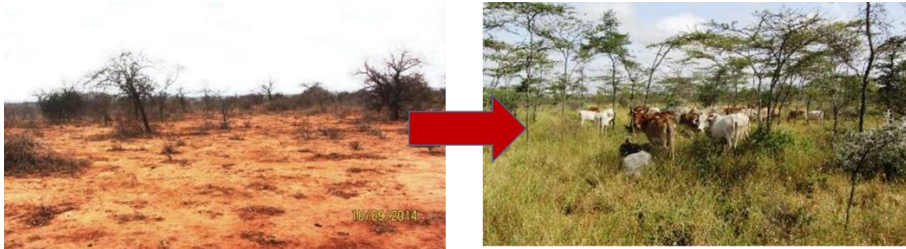
TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Natural Pasture Improvement	2.1.1 Natural pasture improvement through reseeded	Management practice	Ready for up scaling
2.2 Pastoral and agro-pastoral seed Systems	2.2.1 Kiboko Range pits for water harvesting for pasture production	Innovation	Ready for up scaling
	2.2.2 Community based range grass seed bulking and management practices	Management practice	Ready for up scaling
	2.2.3 Irrigated forage production in ASALs	Management practice	Require further research
	2.2.4 <i>Cenchrus ciliaris</i> (Buffel grass) var. MGD-1	Technology	Require further research
	2.2.5 <i>Cenchrus ciliaris</i> (Buffel grass) var. TVT-3	Technology	Require further research
	2.2.6 <i>Eragrostis superba</i> var. (ERSU-1)	Technology	Require further research
2.3 Supplementary Feeding of Range Livestock	2.3.1 <i>Acacia tortilis</i> supplement for weaner goats and sheep	Management practice	Ready for up scaling.
	2.3.2 <i>Prosopis juliflora</i> pods flour for improved livestock productivity	Management practice	Ready for up scaling.
	2.3.3 Cotton seedcake as supplementary feed for beef cattle	Management practice	Ready for up scaling
	2.3.4 Cost effective feed conservation structure	Management practice	Ready for up scaling
	2.3.5 AZOLLA blended feeds for improved beef production and productivity	Management practice	Require further research

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.4 Pastoral and Agro-pastoral Information System	2.4.1 Matching livestock production with the market needs	Management practice	Ready for up scaling
	2.4.2 Carbon sequestration in grasslands ecosystems	Management practice	Ready for up scaling
	2.4.3 Utilization of traditional indicators for weather prediction in pastoral and agro-pastoral systems	Management practice	Require validation and proper documentation
	2.4.4 Socio economics of reseeding rangelands in Kenya	Management practice	Ready for up scaling

**Note:** These TIMPs are suitable for: West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit and Tana River counties.

## 2.0 DETAILED PASTURES AND FOLDED VALUE CHAIN TIMPS

### 2.1 Natural Pasture Improvement

TIMP Name	2.1.1 Natural pasture improvement through reseeding
Category	Management Practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low livestock production due feed shortage as a result to degradation
What is it? (TIMP description)	<p>Degraded natural pasture is fenced and over sown with selected grasses with micro catchments such as furrows made by oxen plough or pits. Through the reseeding degraded pastures are improved to continue supporting livestock faster than if natural regeneration was allowed to take its course.</p>  <p>Degraded land vs rehabilitated range land</p>
Justification	There is need to address degradation of rangelands to increase natural pasture production. With faster pasture regeneration, the rangelands are not only able to support increased livestock but also land holding capacity and livestock productivity.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Ranchers, Small scale farmers, Extension Agents and Researchers
Approaches to be used in dissemination	Field days, posters, demonstrations on-station and on-farm, CBOs, Innovation paltforms, Pastoral/Farmer Field School (PFS/FFS)
Critical/essential factors for successful promotion	Capacity building for management practice users including demonstrations and availability of viable seeds

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• MoALF&amp;C- Capacity building and funding</li> <li>• County governments to train farmers and help them access the seeds</li> <li>• KEPHIS to provide seed certification to facilitate commercialization of the seed system</li> <li>• NGOs to assist in capacity building of farmers and provide financial support</li> <li>• Farmer groups lobby members to adopt TIMP and engage in commercial seed production and marketing</li> <li>• Commercial multipliers and seed merchants to stock and distribute certified seed</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Moyale, Mandera, Wajir, Isiolo, Narok, Kajiado, Taita Taveta, Machakos, Mwingi, Makueni
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	Cultural practices with respect to control and access to land, inadequate extension services, unreliable rains and land tenure
Recommendations for addressing the challenges	Improved extension, training of trainers, bulking and germination testing of seeds
Lessons learned in up scaling if any	Use of micro catchments aid in better establishment, fencing necessary, best at onset of short rains, use more than one grass species to spread the risks, utilization should be at the end of second growing season
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Under communal land tenure community consensus is necessary</li> <li>• Pastoralists resist micro catchments involving tillage and prefer seed broadcasting into existing vegetation and some fencing</li> <li>• Awareness creation about importance of protection of the over-sown area is necessary especially among the pastoralists otherwise some will complain of being denied access to the natural pastures</li> <li>• Extensive fencing necessary to facilitate establishment</li> <li>• Testing of soils before planting to establish the soil condition (PH, Nutrients) is required</li> <li>• In weed management, integrated pest management will be used and in situations where herbicides and pesticides must be used, only those recommended by pesticides control board and cleared by the world bank will be used</li> <li>• Reliable market for livestock is good incentive for technology adoption</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES. 7000./acre (for pasture seeds and labour)
Estimated returns	KES 37,500/acre (i.e. from 150 bales @ KES 250)
Gender issues and concerns in development,	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> </ul>


dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Low cost technology for women/youth to be involved</li> <li>• Training and extension services are need to be targeted to women/youth in tandem with the other daily tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Availability of forage has potential of increasing milk production to meet the food and nutrition security of all the gender categories in the household</li> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• Women may engage in commercial seed production and marketing (they are more efficient in harvesting grass seeds than their male counterpart)</li> <li>• Hay baling is a manual task that women/ youth can get into to get some household income</li> <li>• There opportunity for transporting hay for youth</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to agricultural information, technology and knowledge</li> <li>• Slow information and awareness flow to VMGs due to low academic levels</li> <li>• Lack of awareness by VMGs will lead to low adoption of pasture reseeding technologies</li> <li>• Fairly low cost technology for VMGs</li> <li>• Extension and training need to have message tailored for VMGs</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• With improved livestock production, VMGs will get more animal products for their consumption hence improved health</li> <li>• VMGs stand to make more money from livestock and could therefore hire labour to reseed the pastures</li> <li>• Business opportunity for VMGs through sale of seed</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from similar previous projects	<ul style="list-style-type: none"> <li>• Utheu Wa Aka women group in Kibwezi successfully used the technology to improve their natural pastures thus enhancing capacity to feed their livestock</li> <li>• KAPALIG (KAVATINI Pasture and Livestock Improvement group) also successfully used the technology.</li> </ul>
Application guidelines for users	<p>Proceedings Of Training Of Trainers Workshop For The Mandera Triangle In Community Based Range Forage Seed System.</p> <p><a href="https://moam.info/kenya-agricultural-research-institute_599ec44d1723dd0c4031e751.html">https://moam.info/kenya-agricultural-research-institute_599ec44d1723dd0c4031e751.html</a></p>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p>Institute Director  ARLRI Kiboko  P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a>  <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a>  <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a></p>

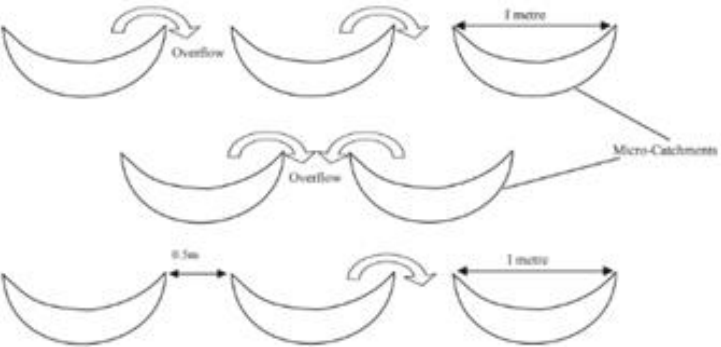

	+254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Peter Mweki, John K. Manyeki, Bosco Kidake, Dennis Kubasu
Partner organizations	County governments; CBOs e.g. KAPALIG, MoALF&C

### Gaps

1. National Performance Trials and Distinctiveness Uniformity and Stability of the grass varieties needed to facilitate registration and formal release by KEPHIS. This will facilitate formal marketing of the range grass seeds, thus adoption of the Community based range grass seed bulking TIMP.
2. There is need to conduct feeding trials for all the range grass varieties being promoted to check on animal performance. This has not been done even on the indigenous grasses that are already being promoted for establishment of new pasture fields and rehabilitation of degraded rangelands. Results of the trials would provide evidence for farmers to adopt the grass varieties.
3. There is need to expand capacity of Kiboko Centre to bulk seeds to complement work by farmer groups and also enable it conduct quality control. Virtually all the 17 ASAL counties will require grass seeds. This would support/facilitate adoption of the various indigenous range grasses as well as the new varieties that are being developed.

## 2.2 Pastoral and agro-pastoral seed Systems

<b>TIMP Name</b>	<b>2.2.1 Kiboko Range pits for water harvesting for pasture production</b>
Category	Innovation
A: Description of technology, innovation or Management practice	
Problem to be addressed	Low pasture production due inadequate moisture (rainfall <250mm seasonally)
What is it? (TIMP description)	<p>Range pits are about 1m x 0.5 and 30cm deep crescent (half-moon), shaped pits placed in staggered rows appropriate to harvest runoff water in the arid and semi-arid lands (ASALs) receiving 250mm of rainfall and below. The pits trap runoff and allows more infiltration leading to great moisture retention that enable higher pasture establishment.</p> 

	<p>Range pits at a Mr. Ngaya's farm in Kavatini, Makueni</p>  <p style="text-align: center;"><b>Layout of range pits</b></p>  <p style="text-align: center;"><b>Grass seedlings emerging on range pits</b></p>
Justification	The range pits retains the runoff on site thus allowing greater infiltration and higher soil moisture. The resulting improvements supports better pasture establishment in the ASALs regions.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Livestock keepers, commercial pasture growers and extension providers
Approaches to be used in dissemination	Field days, exhibitions, posters, brochures, demonstrations and mass media
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Simple affordable motorized equipment and readiness to adopt land tillage pitting. Works better on land with sandy clay and loam soils and 8% slope.</li> <li>• Economic information.</li> <li>• Rocky and steeper slopes may present serious challenges.</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• MoALF&amp;C, to assist in funding and capacity building.</li> <li>• County governments, to provide extension support, funding, capacity building and planting materials</li> </ul>

	<ul style="list-style-type: none"> <li>• Farmers, NGOs and CBOs involved in livestock development and improvement to provide extension services, advocacy, planting materials and funding mobilize farmers to seek and apply TIMP.</li> <li>• Sellers of agro equipment such as CAMCO, etc.</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kajiado, Taita Taveta, Makueni, Machakos, Mandera, Marsabit
Counties where TIMP will be up scaled	Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River, West Pokot, Baringo, Laikipia, Lamu
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Lack of resources to fund extensive dissemination.</li> <li>• Unavailability of economic information on TIMP</li> </ul>
Suggestions for addressing challenges	<ul style="list-style-type: none"> <li>• Work in groups from farm to farm (merry-go-round); Consult community based trainers</li> <li>• Increase collaboration between GOK, NGOs and private extension service providers for extension and information</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Farmers prefer pitting on steep slopes but trap more water from cut-off drains collecting water from runoff.</li> <li>• Pits still confer more benefits than farrows if a farmer has the ability to make them</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Mechanization of pit making will help popularize the technology. Good market for pasture &amp; pasture seeds, milk, live animals</li> <li>• Favourable agricultural policies to offer better prices of agricultural products</li> <li>• Good agricultural policies that support extension services</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	Approx. KES. 8,000/acre (labour cost for making pits)
Estimated returns	Approx. KES 37,500 (150 bales/ha @ 250)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Women and youth may not manage to raise the high start-up capital for irrigation infrastructure and other inputs</li> <li>• Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• There are employment opportunities for the youth and women</li> <li>• Higher productivity of the forages stand to increase both milk yield and quality of beef thus increasing nutrition and income</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for planting stunt and smut tolerant varieties</li> </ul>

	<ul style="list-style-type: none"> <li>• VMGs lack funds to acquire required inputs</li> <li>• Pitting is difficult for VMGs – particularly for the physically challenged. Unlikely to benefit much owing to limited adoption.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of products</li> </ul>
E: Case studies/profiles of success stories	
Success stories from similar previous projects	Kavatini Pasture & Livestock Improvement Group (KAPALIG), a CIG in Makueni successfully used the technology jointly with run-off harvesting to establish/pasture fields.
Application guidelines for users	Proceedings Of Training Of Trainers Workshop For The Manderu Triangle In Community Based Range Forage Seed System. <a href="https://moam.info/kenya-agricultural-research-institute_599ec44d1723dd0c4031e751.html">https://moam.info/kenya-agricultural-research-institute_599ec44d1723dd0c4031e751.html</a>
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling under the conditions it was developed. However, it requires further research in areas with steeper slopes and other types of soil.
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Denis Kubasu
Partner organizations	MoALF&C, County governments, CIGs and other Farmers' groups

### Gaps

1. An implement to facilitate adoption of the Kiboko Range Pits TIMP is needed – fabrication, validation and dissemination.
2. Require validation for different slope gradients and soils.

<b>TIMP Name</b>	<b>2.2.2 Community based range grass seed bulking &amp; management practices</b>
Category	Management Practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low pasture production due limited availability of range grass seeds
What is it? (TIMP description)	Management package for community-based range grass seed production, harvesting, processing, bulking and storage for small and medium scale livestock keepers/producers. It is an essential management practice

that ensures the successful restoration of degraded rangelands. The approach when done well to involve a big part of the community, guarantees availability and marketing of good quantity and quality seed locally and beyond. The areas are managed to ensure regeneration and this makes the rangelands more productive and resilient to continue supporting livestock.



*Women harvesting grass seed*



*Drying of harvested grass seeds*

Justification	By enabling the farmers to access quality pasture seed at the community level, they are able grow enough pastures which increases availability of feed for their livestock.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	County governments, Common Interest Groups (CIGs), Individual farmers, MoALF&C, Extension Agents
Approaches to be used in dissemination	Training of CIGs, Farmers, Traininf of Trainers, Farmer Field and Business Schools (FFBs), On-farm demonstrations
Critical/essential factors for successful promotion	Business orientation of the farmers, availability of initial seeds, land to establish the seed bulking fields, adequate moisture, availability of seed germination testing services, availability of viable markets for the seeds



Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County governments – Training of farmers, funding extension services</li> <li>• Common Interest Groups (CIGs) – Produce and market the seeds, train farmers,</li> <li>• Individual farmers – Produce and market seeds</li> <li>• MoALF&amp;C – Train extension personnel, funding</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Makueni, Taita Taveta, Kajiado, Narok, Tana River
Counties where TIMP will be up scaled	West Pokot, Baringo, Lamu, Machakos, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate support of extension staff by county governments to carry out the dissemination work</li> <li>• Poor group dynamics</li> <li>• Limited availability of starter seeds.</li> </ul>
Recommendations for addressing challenges	<ul style="list-style-type: none"> <li>• County governments to provide more support to extension staff</li> <li>• Provision of more resources to KALRO staff to train more CIGs</li> <li>• Address group dynamic issues</li> <li>• Conduct cost benefit analysis of the technology</li> </ul>
Lessons learned in up scaling if any	Building capacity of farmers to engage in commercial seed bulking not only helps in rehabilitating degraded rangelands but can also positively transform the lives of farmers through the generated revenue.
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Strong group dynamics is important for success of the group activities</li> <li>• Untrained groups should not engage in the activity otherwise they spoil the markets for the trained groups by offering seeds of questionable quality.</li> <li>• Availability of market for the seeds to motivate the farmers is crucial.</li> <li>• Registration and formal release of grass varieties by KEPHIS is crucial to facilitate formal marketing of the seeds.</li> <li>• Registering the producer groups as seed merchants with KEPHIS to facilitate marketing is necessary.</li> <li>• Testing of soils before planting to establish the soil condition (PH, Nutrients) is required.</li> <li>• In weed management, integrated pest management should be used and in situations where herbicides and pesticides must be used, only those recommended by pesticides control board and cleared by the World Bank will be used.</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 5,000 (5 kg of seed @ 1,000) per acre
Estimated returns	KES 70,000 (100kg of seed @ 700)

Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> <li>• Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Seed bulking is a source of household income when the seeds are sold and income shared among members</li> <li>• Good market for pasture &amp; pasture seeds, milk, live animals leads to increased incomes for women</li> <li>• Avail seed at affordable cost</li> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• There are employment opportunities for the youth and women</li> <li>• Higher productivity of the forages stand to increase both milk yield and quality of beef thus increasing nutrition and income</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs lack funds to acquire required inputs</li> <li>• VMGs may not be able to reach far way markets or have bargaining power</li> <li>• VMGs may be excluded from decision making during dissemination because of their social status</li> <li>• Lack of awareness by VMGs will lead to low adoption of pastoral and agro-pastoral seed systems technologies</li> <li>• Initial establishment is a challenge to VMGs</li> <li>• Associated activities are manually done including land preparation, planting, harvesting and shelling which presents a challenge to the VMGs in terms of adoption and scaling up.</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of products</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	The success registered by Kavatini Pastoralists Livestock Improvement Group (KAPALIG) is worth telling. Some members have completely transformed their lives using proceeds from seed sales. The members have also succeeded in training other farmers and are invited to go and train other farmers outside Makueni County.
Application guidelines for users	Mnene W.N, Kirwa, E.C., Kidake, B.K., Ogillo B.P., Kubasu D. and Kimitei R.. (2017). How to produce quality range grass seed manual. <a href="https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf">https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf</a>

<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling.
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu GeRRI Muguga Dr. Everlyne Kirwa
Partner organizations	County governments, Farmer groups, MoALF&C

### Research Gaps

1. However, it requires registration of the seeds by KEPHIS for wider formal marketing
2. Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP.

<b>TIMP Name</b>	<b>2.2.3 Irrigated forage production in ASALs</b>
Category	Technology
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low pasture production (quantity and quality) feed for livestock in ASALs due to inadequate moisture
What is it? (TIMP description)	It is the growing of ASAL high value pastures and fodder varieties known to perform well under irrigation to supplement rain fed pasture production. The varieties/species include fodder sorghum e.g. Sugargraze & Sudan grass, fodder millet e.g Nutrifeed, range grass e.g. <i>Cenchrus ciliaris</i> & <i>Eragrostis superba</i> ; and fodder legumes such as Cowpea M66.
 <p>Growing pastures under irrigation</p>	

	<i>Pastures established under irrigation</i>
Justification	Growing of forage in pastoral communities under irrigation reduces land and resource use conflict especially during drought. Irrigation enables the producers to get at least three harvests in a year. Irrigated fodders could be in areas near permanent water sources and could be stockpile for release when needed. Alternatively, it may be suitable for counties with farmer groups that may establish feedlots for fattening animals. Initially, dry season grazing areas were planted with maize which benefit only a few households.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Agro pastoralists and pastoralists, Extension Agents
Approaches to be used in dissemination	On-farm Demonstration, Field Days, Agricultural shows, FFBS
Critical/essential factors for successful promotion	Reliable sources of water is a must
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• MoALF&amp;C – Training extension personnel on the TIMP, providing funds for dissemination</li> <li>• County governments – extension staff to train farmers,</li> <li>• NGO and CBOs supporting livestock development – train farmers, facilitate farmers to access the TIMP and additional funds</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Marigat (Baringo), Tana North (Tana River), Taita Taveta, Mbalabala (Garissa) sub-counties in Kenya and North West Tanzania
Counties where TIMP will be up scaled	Garissa, Tana river, Mandera and wherever else there is reliable water
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited knowledge/awareness of farmers on how to carry out irrigated pastures</li> <li>• Low availability and high cost of grass seed</li> <li>• High start-up capital for irrigation infrastructure</li> </ul>
Recommendations for addressing challenges	<ul style="list-style-type: none"> <li>• Training and awareness creation</li> <li>• Avail seed at affordable cost and provision of financial services</li> <li>• Linking farmers to Micro-financing institutions</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Irrigated forage production in ASALs is profitable, irrigated forage production cushions livestock during drought.</li> <li>• Promote mechanized ways of making the furrows or adopt overhead irrigation</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Avoid conflict between pastoralists and agro-pastoralists, over abstraction of water can lead to drying up of water sources, good market for hay is a good motivation for investors.</li> </ul>


	<ul style="list-style-type: none"> <li>• Testing of soils before planting to establish the soil condition (PH, Nutrients) is required.</li> <li>• In weed management, integrated pest management will be used and in situations where herbicides and pesticides must be used, only those recommended by pesticides control board and cleared by the World Bank will be used.</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES.7,000 and 14,000 using draught power or tractor per acre excluding cost of water pump
Estimated returns	KES. 30,000/ha
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> <li>• Access to land and funds may limit the technology to women</li> <li>• Women and youth may not manage to raise the high start-up capital for irrigation infrastructure and other inputs</li> <li>• Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• There are employment opportunities for the youth and women</li> <li>• Irrigated forage reduces amount of time women take in looking for feed for young stock.</li> <li>• Higher productivity of the forages stand to increase both milk yield and quality of beef thus increasing nutrition and income</li> <li>• Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs lack funds to acquire required inputs</li> <li>• VMGs have limited access to agricultural information, technology and knowledge</li> <li>• Slow information and awareness flow to VMGs due to low academic levels</li> <li>• VMGs may not be able to reach far way markets or have bargaining power</li> <li>• VMGs may be excluded from decision making during dissemination because of their social status</li> <li>• Lack of awareness by VMGs will lead to low adoption of pastoral and agro-pastoral seed systems technologies</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of</li> </ul>

	products
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Case of Korio Farm and Biskidera Jabesa group in Tana North, Singale Buradanza Tiltil Farms in Mbalabala, Garissa. These groups used the technology to successfully establish pastures.
Application guidelines for users	Proceedings Of Training Of Trainers Workshop For The Manderu Triangle In Community Based Range Forage Seed System. <a href="https://moam.info/kenya-agricultural-research-institute_599ec44d1723dd0c4031e751.html">https://moam.info/kenya-agricultural-research-institute_599ec44d1723dd0c4031e751.html</a>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Requires validation
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu
Partner organizations	TALIRI in MABUKI Tanzania; OARI in Yabello Ethiopia

#### Gaps

1. Requires further research to determine the water requirement per unit of land
2. Cost/benefit analysis of mechanizing the technology needs to be done

<b>TIMP Name</b>	<b>2.2.4 <i>Cenchrus ciliaris</i> (Buffel grass) var. MGD-1</b>
Category	Technology
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Feed shortage, low livestock productivity and rangeland degradation
What is it? (TIMP description)	It is a range grass variety that is drought resistant, tolerant to grazing pressure and matures in 3-4 months with, CP up to 12%, high digestibility, Suitable for cut and carry or baling, good for rangeland rehabilitation, competitive and aggressive growth against weeds, good for soil erosion control, early maturing and vigorous growth after harvest, free from pests and diseases. Over 20 years of productive life with proper management


	 <p style="text-align: center;"><i>C. ciliaris</i> var MGD-1</p>
Justification	<p>The indigenous range grass species have been used by livestock producers in the ASALs for a long time. However, performance of the grasses in terms of biomass yield, nutritive value, drought tolerance, tolerance to grazing etc. has not been good enough to satisfy the feeds needs of grazing livestock leading to declining productivity of the livestock. This makes it necessary to explore ways of improving performance of the grasses and one of the options is that identifying and promoting superior ecotypes while other options would include breeding to develop completely new varieties.</p>
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	<p>Researchers for further work including breeding, Extension personnel, farmer groups, CIGs and individual farmers</p>
Approaches to be used in dissemination	<p>Field days, posters, demonstrations on-station and on-farm, CBOs</p>
Critical/essential factors for successful promotion	<p>Adaptation trials in different locations and, registration of the ecotypes with KEPHIS</p>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KEPHIS- Certification of the varieties</li> <li>• County governments – training farmers on the varieties, assist farmers access the seeds</li> <li>• Farmer groups – use the varieties to produce feed for their livestock or sale</li> <li>• Research Organisations- Further Research</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	<p>Not promoted still under verification</p>
Counties where TIMP will be up scaled	<p>Kajiado, Makueni, Narok, Kitui, Taita Taveta, Baringo, Nakuru, Busia, Laikipia, Machakos, Kilifi, West Pokot</p>
Challenges in dissemination	<p>Still under validation</p>
Suggestions for addressing challenges	<p>N/A (still under verification)</p>
Lessons learned in up scaling if any	<p>N/A (still under verification)</p>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Land availability is a must in ASAL area</li> <li>• The ecotypes/varieties should be registered with KEPHIS in order to be sold through formal channels</li> </ul>

	<ul style="list-style-type: none"> <li>• Testing of soils before planting to establish the soil condition (PH, Nutrients) is required</li> <li>• In weed management, integrated pest management will be used and in situations where herbicides and pesticides must be used, only those recommended by pesticides control board and cleared by the world bank will be used</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 5,000/acre
Estimated returns	KES 70,000 (70kg grass seeds @ KES 1000) or KES 37,500 (150 bales @ KES 250)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> <li>• Access to land and funds may limit the technology to women</li> <li>• Women and youth may not manage to raise the high start-up capital for irrigation infrastructure and other inputs</li> <li>• Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Good market for pasture &amp; pasture seeds, milk, live animals leads to increased incomes for women</li> <li>• Avail seed at affordable cost</li> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• There are employment opportunities for the youth and women</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs lack funds to acquire required inputs</li> <li>• VMGs have limited access to agricultural information, technology and knowledge</li> <li>• Slow information and awareness flow to VMGs due to low academic levels</li> <li>• VMGs may not be able to reach far way markets or have bargaining power</li> <li>• VMGs may be excluded from decision making during dissemination because of their social status</li> <li>• Lack of awareness by VMGs will lead to low adoption of pastoral and agro-pastoral seed systems technologies</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of products</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Still under validation

Application guidelines for users	Under development
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Requires further research including cost benefit analysis
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	GeRRI Muguga Dr. Everlyne Kirwa KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu
Partner organizations	KEPHIS, County governments, farmers and farmer groups

## Research Gaps

1. National Performance Trials and Distinctiveness Uniformity and Stability of the grass varieties needed to facilitate registration and formal release by KEPHIS.
2. Need to develop improved varieties by crossing the Kiboko 1 (KBK1), Magadi 3 (MGD3) and Kilifi 1 (KLF1) ecotypes to facilitate adoption of the CECI ecotypes.
3. There is need to conduct feeding trials for all the range grass varieties being promoted to gauge on animal performance. This has not been done even on the indigenous grasses that are already being promoted for establishment of new pasture fields and rehabilitation of degraded rangelands. Results of the trials would provide evidence for farmers to adopt the grass varieties.
4. As improvements in the quality and quantity of range pastures through application of the TIMPs on Natural Pasture Improvement; Community based range grass seed bulking; *Cenchrus ciliaris* and *Eragrostis superba* ecotypes continue, it is worth noting that these pastures alone cannot finish beef livestock in a way that they would attain market weights early enough while the meat is still tender. It is therefore imperative to develop more comprehensive beef and goat/sheep finishing strategies based on locally available material.
5. There are a number of naturally occurring legumes in ASALs which need to be explored with a view of domesticating, bulking the planting material and disseminating the same to producers for use as protein sources in finishing beef, mutton and chevon.
6. Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP.

<b>TIMP Name</b>	<b>2.2.5 <i>Cenchrus ciliaris</i> (Buffel grass) var. TVT-3</b>
Category	Technology
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Feed shortage, low livestock productivity and rangeland degradation
What is it? (TIMP description)	<p>It is a range grass that is drought tolerant, tolerant to grazing pressure and matures in 3-4 months. Suitable for cut and carry or baling. It is palatable and preferred at optimal nutritive stage CP up to 11%. It is a prolific in seed producer. The pasture spreads easily through rhizomes and competitively aggressive grows against weeds. Good for soil erosion control. Over 20 years of productive life with proper management</p>  <p style="text-align: center;"><b><i>Cenchrus ciliaris</i> var. TVT-3</b></p>
Justification	The indigenous range grass species have been used by livestock producers in the ASALs for a long time. However, performance of the grasses in terms of biomass yield, nutritive value, drought tolerance, tolerance to grazing etc. has not been good enough to satisfy the feeds needs of grazing livestock leading to declining productivity of the livestock. This makes it necessary to explore ways of improving performance of the grasses and one of the options is that identifying and promoting superior ecotypes while other options would include breeding to develop completely new varieties.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Researchers for further work including breeding, Extension personnel, farmer groups, CIGs and individual farmers ,
Approaches to be used in dissemination	Field days, posters, demonstrations on-station and on-farm, CBOs
Critical/essential factors for successful promotion	Adaptation trials in different locations and, registration of the ecotypes with KEPHIS
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KEPHIS- Certification of the varieties</li> <li>• County governments – Training farmers on the varieties, assist farmers access the seeds</li> <li>• Farmer groups – Use the varieties to produce feed for their livestock or sale</li> </ul>


	<ul style="list-style-type: none"> <li>• Research Organizations- Further Research and Validation</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Not yet promoted
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	Not yet captured
Suggestions for addressing challenges	N/A
Lessons learned in up scaling if any	N/A
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Land availability is a must in ASAL area</li> <li>• The ecotypes/varieties should be registered with KEPHIS in order to be sold through formal channels</li> <li>• Testing of soils before planting to establish the soil condition (PH, Nutrients) is required</li> <li>• In weed management, integrated pest management will be used and in situations where herbicides and pesticides must be used, only those recommended by pesticides control board and cleared by the world bank will be used</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 5,000/acre
Estimated returns	KES 70,000 (70kg grass seeds @ KES 1000) or KES 37,500 (150 bales @ KES 250)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> <li>• Access to land and funds may limit the technology to women</li> <li>• Women and youth may not manage to raise the high start-up capital for irrigation infrastructure and other inputs</li> <li>• Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Buffel grass is a drought tolerant, and matures in 3-4 months, hence a source of household income through increased live production</li> <li>• Good market for pasture &amp; pasture seeds, milk, live animals leads to increased incomes for women</li> <li>• Avail seed at affordable cost</li> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• There are employment opportunities for the youth and women</li> </ul>

VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for planting stunt and smut tolerant varieties</li> <li>• VMGs lack funds to acquire required inputs</li> <li>• VMGs have limited access to agricultural information, technology and knowledge</li> <li>• Slow information and awareness flow to VMGs due to low academic levels</li> <li>• VMGs may not be able to reach far way markets or have bargaining power</li> <li>• VMGs may be excluded from decision making during dissemination because of their social status</li> <li>• Lack of awareness by VMGs will lead to low adoption of Buffel grass</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of products</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	No experience at farmer level.
Application guidelines for users	Not developed
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Requires further research including cost benefit analysis of using the varieties
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	GeRRI Muguga Dr. Everlyne Kirwa KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu
Partner organizations	KEPHIS, County governments, farmers and farmer groups

### Research Gaps

1. National Performance Trials and Distinctiveness Uniformity and Stability of the grass varieties needed to facilitate registration and formal release by KEPHIS.
2. Need to develop improved varieties by crossing the Kiboko 1 (KBK1), Magadi 3 (MGD3) and Kilifi 1 (KLF1) ecotypes to facilitate adoption of the CECI ecotypes.

3. There is need to conduct feeding trials for all the range grass varieties being promoted to gauge on animal performance. This has not been done even on the indigenous grasses that are already being promoted for establishment of new pasture fields and rehabilitation of degraded rangelands. Results of the trials would provide evidence for farmers to adopt the grass varieties.
4. As improvements in the quality and quantity of range pastures through application of the TIMPs on Natural Pasture Improvement; Community based range grass seed bulking; *Cenchrus ciliaris* and *Eragrostis superba* ecotypes continue, it is worth noting that these pastures alone cannot finish beef livestock in a way that they would attain market weights early enough while the meat is still tender. It is therefore imperative to develop more comprehensive beef and goat/sheep finishing strategies based on locally available material.
5. There are a number of naturally occurring legumes in ASALs which need to be explored with a view of domesticating, bulking the planting material and disseminating the same to producers for use as protein sources in finishing beef, mutton and chevon.
6. Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP.

TIMP Name	2.2.6 <i>Eragrostis superba</i> var. (ERSU-1)
Category	Technology
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Feed shortage, low livestock productivity and rangeland degradation
What is it? (TIMP description)	<p>These are high performing, well adapted, livestock preferred and good seeder ecotypes selected from indigenous <i>Eragrostis superba</i>. The ecotypes are more productive in terms of dry matter and crude protein (9-11.5%) levels. They have higher digestibility than existing forages besides being more adaptable to moisture.</p> <div style="text-align: center;">  <p><i>Variety ERSU-1</i></p> </div>
Justification	The indigenous range grass species have been used by livestock producers in the ASALs for a long time. However, performance of the grasses in terms of biomass yield, nutritive value, drought tolerance, tolerance to grazing etc. has not been good enough to satisfy the feeds needs of grazing livestock leading to declining productivity of the livestock. This makes it necessary to explore ways of improving performance of the grasses and one of the options is that identifying and promoting superior ecotypes while other options would include breeding to develop completely new varieties.

<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Researchers for further work including breeding, Extension personnel, farmers, farmer groups and county governments ,
Approaches to be used in dissemination	Field days, posters, demonstrations on-station and on-farm, CBOs
Critical/essential factors for successful promotion	Adaptation trials in different locations and, Registration of the ecotypes with KEPHIS
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• KEPHIS - Certification of the varieties</li> <li>• County governments – training farmers on the varieties, assist farmers access the seeds</li> <li>• Farmer groups – use the varieties to produce feed for their livestock or sale</li> <li>• NGOs-to assist in building the capacity of farmers to take up new knowledge</li> <li>• Research Organization-Further Research and validation</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Not promoted
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	Not yet captured
Suggestions for addressing challenges	N/A
Lessons learned in up scaling if any	N/A
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Land availability is a must in ASAL area and the ecotypes/varieties should be registered with KEPHIS in order to be sold through formal channels</li> <li>• Testing of soils before planting to establish the soil condition (PH, Nutrients) is required</li> <li>• In weed management, integrated pest management will be used and in situations where herbicides and pesticides must be used, only those recommended by pesticides control board and cleared by the world bank will be used</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 4,000/acre
Estimated returns	KES 80,000 (100kg grass seeds @ KES 800) or KES 37,500 (150 bales @ KES 250)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> <li>• Access to land and funds may limit the technology to women</li> <li>• Women and youth may not manage to raise the high start-up capital for irrigation infrastructure and other inputs</li> </ul>


Gender related opportunities	<ul style="list-style-type: none"> <li>• Good market for pasture &amp; pasture seeds, milk, live animals leads to increased incomes for women</li> <li>• Avail seed at affordable cost</li> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• There are employment opportunities for the youth and women</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs have limited access to land for planting stunt and smut tolerant varieties</li> <li>• VMGs lack funds to acquire required inputs</li> <li>• VMGs have limited access to agricultural information, technology and knowledge</li> <li>• Slow information and awareness flow to VMGs due to low academic levels</li> <li>• VMGs may not be able to reach far way markets or have bargaining power</li> <li>• VMGs may be excluded from decision making during dissemination because of their social status</li> <li>• Lack of awareness by VMGs may lead to low adoption of the ERSU-1</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of products</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	<i>Eragrostis superba</i> is a perennial grass that is well adapted to the ASAL. No experience at farmer level.
Application guidelines for users	Not developed
<b>F: Status of the TIMP</b> readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Requires further research including the cost benefit analysis of using the technology
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	GeRRI Muguga Dr. Everlyne Kirwa KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu
Partner organizations	KEPHIS, County governments

## Research Gaps

1. National Performance Trials and Distinctiveness Uniformity and Stability of the grass varieties needed to facilitate registration and formal release by KEPHIS.
2. Need to develop improved varieties by crossing the ecotypes Kiboko 1(KBK1), Kiboko 2 (KBK2) & Kilifi 1 (KLF1) ecotypes to facilitate adoption of the ERSU ecotypes
3. There is need to conduct feeding trials for all the range grass varieties being promoted to check on animal performance. This has not been done even on the indigenous grasses that are already being promoted for establishment of new pasture fields and rehabilitation of degraded rangelands. Results of the trials would provide evidence for farmers to adopt the grass varieties.
4. As improvements in the quality and quantity of range pastures through application of the TIMPs on Natural Pasture Improvement; Community based range grass seed bulking; *Cenchrus ciliaris* and *Eragrostis superba* ecotypes continue, it is worth noting that these pastures alone cannot finish beef livestock in a way that they would attain market weights early enough while the meat is still tender. It is therefore imperative to develop more comprehensive beef and goat/sheep finishing strategies based on locally available material
5. There are a number of naturally occurring legumes in ASALs which need to be explored with a view of domesticating, bulking the planting material and disseminating the same to producers for use as protein sources in finishing beef, mutton and chevon.
6. Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP

### 2.3 Supplementary Feeding of Range Livestock

<b>TIMP Name</b>	<b>2.3.1 <i>Acacia tortilis</i> pods supplement for weaner goats and sheep</b>
<b>Category</b>	Management Practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low livestock productivity due to poor quality feeds, inadequate feed supply and unaffordable high cost of commercial supplements
What is it? (TIMP description)	<i>Acacia tortilis</i> pods are potentially invaluable protein concentrate for small ruminants, high in crude protein (18%), acid detergent fibre (ADF) 27.3%, Metabolizable Energy (ME) 8.7 MJ/kgDM and dry matter intake (46%) which enhances feed intake thus increased weight gain.

	 <p style="text-align: center;"><i>Acacia tortilis</i> pods</p>
Justification	Highly invaluable <i>Acacia tortilis</i> pods is a good alternative supplement to expensive commercial feeds. High protein content and dry matter digestibility of <i>Acacia tortilis</i> pods enhance growth of weaner goats and sheep in the ASAL regions.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Large and small scale livestock keepers
Approaches to be used in dissemination	Field days, posters, brochures, farmer groups tours, field demonstrations
Critical/essential factors for successful promotion	Availability of the pods, farmer willingness to participate, Availability of processing machines
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Farmers – To apply the TIMP and improve their livestock performance</li> <li>• County governments – Capacity building of farmers</li> <li>• MoALF&amp;C – Capacity building of extension staff</li> <li>• NGOs and CBOs - Assist with capacity building of farmers and also in funding</li> <li>• Farmer groups – collection and distribution of pods to farmers, conservation of the tree</li> <li>• KALRO and other research organisations- Further research</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Kajiado, Makueni and Marsabit
Counties where TIMP will be up scaled	West Pokot, Baringo, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate extension services by the County Government</li> <li>• Inadquate resources for for disseminating information to the community</li> <li>• Lack of awareness of the benefits <i>Acacia tortilis</i> pods</li> </ul>
Recommendations for addressing challenges	<ul style="list-style-type: none"> <li>• The County Government can collaborate with private extention agents and NGOs for extension services and information</li> <li>• Educate the local community on the benefits of <i>Acacia tortilis</i> pods</li> <li>• Need to establish and protect/conserv the existing trees</li> </ul>
Lessons learned in up scaling if any	Successful adoption of the technology requires availability of ready and consistent market for anticipated increased livestock production. Involvement of frontline extension staff and CBOs is crucial to help in wide coverage


Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Favourable policies to support and improve conservation /harvesting of <i>Acacia tortilis</i> pods,</li> <li>• Policies to support livestock production, access to market and market prices</li> <li>• Farmers willingness to adopt the technology</li> <li>• Favourable weather conditions</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 180 feed cost per goat for 3 months
Estimated returns	KES 2,400 per goat for (The animal gains 30 kg after being fed on the supplement for 18weeks, assuming live-weight price of KES 80 per kg)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Involvement of women and youth in harvesting the pods stand a chance to register higher levels of adoption due to <i>Acacia tortilis</i> pods availability.</li> <li>• Slow flow of information and awareness for female farmers due to low levels education</li> <li>• Capacity building of women and youth on need to conserve and provide feeds for livestock throughout the year</li> <li>• Increased labour for women who are already overburdened may reduce their chance of adopting pasture and fodder technologies</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• High chance of adoption of technologies by women and youth who are mainly involved in collecting feeds for animals</li> <li>• Good business opportunity especially in the milling of seeds</li> <li>• Business opportunity for youth and women in fodder trade</li> <li>• Goats/sheep attain market weight faster thus attracting men in small ruminant production. Women and children benefit from increased milk yield, more cash to women and men from milk and goat sales</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may be disadvantaged in terms of lacking capital to establish milling plants</li> <li>• Capacity building of VMGs on need for conserved feeds to provide feed for livestock throughout the year</li> <li>• Collection of the pods is a challenge for the disabled</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Business opportunity for VMGs since Pods are readily available and can be easily collected</li> <li>• Business opportunity for VMGs</li> <li>• More milk for VMGs from milk and goat sales</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	A farmer group in Oloibelbel in Ibbisil Kajiado successfully used the technology to raise goats and sheep
Application guidelines for users	<ul style="list-style-type: none"> <li>• Lengarite I. M., Sagala I. J., Walaga H. K. and Adongo A. O..Supplement lactating goats with <i>Acacia tortilis</i> pods <a href="https://www.kalro.org/oldsite/sites/default/files/Supplement-lactating-goats-Dec2020.pdf">https://www.kalro.org/oldsite/sites/default/files/Supplement-lactating-goats-Dec2020.pdf</a></li> </ul>

	<ul style="list-style-type: none"> <li>• Mabeza, G., Mpfu, I. D., &amp; Masama, E. (2014). Potential of Acacia Tortilis as Protein Concentrate for Goats. <i>Journal of Renewable Agriculture</i>, 49, 52.</li> <li>• Lengarite, M. I., Getachew, G., Akudabweni, L., &amp; Hoag, D. (2014). Supplementary feeding of lactating goats with processed and unprocessed Acacia tortilis pods and local grass in the dry season in northern Kenya. <i>Agricultural Science Research Journal</i>, 4(3), 63-71.</li> <li>• Nyariki, D. M., Araya, M. R., Ngugi, R. K., &amp; Musimba, N. K. R. (2003). Feeding value of Acacia tortilis pods in goats.</li> </ul>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Mr. Korir, R K; Bii J C, Katiku P; Kuria S G
Partner organizations	County governments, MoALF&C, Farmer groups

## Gaps

1. Explore the pods as possible ingredient in the formulation of more balanced supplementary feed rations for finishing beef in ASALs.
2. Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP.

<b>TIMP Name</b>	<b>2.3.2 <i>Prosopis juliflora</i> pods flour for improved livestock productivity</b>
Category	Management practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low livestock productivity due to poor quality feed and high cost of commercial supplements
What is it? (TIMP description)	<i>Prosopis juliflora</i> is an invasive species which produces pods that are widely available in the ASALs. The pods are high in nutritive content (Crude protein (18.5%), Organic matter 83.2%), ADF 29.8%, Gross Energy 18 MJ/kgDM that improves feed intake which translates to high weight gain

	 <p style="text-align: center;"><i>Prosopis juliflora</i> pods</p>
Justification	As a high quality supplementary feed (18.5% crude protein) which is widely available, <i>Prosopis Juliflora</i> , is good for livestock farmers faced with challenges of low livestock performance due to poor quality feed
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Agro-pastoralists and Pastoralists
Approaches to be used in dissemination	On farm demonstration, posters, conferences, mass media and field days
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of <i>P. Juliflora</i>,</li> <li>• Availability of affordable and efficient milling machines</li> <li>• Availability of labour</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County governments’ extension staff – training farmers on the TIMP</li> <li>• NGOs promoting livestock production – funding training of farmers, helping farmers access the pods</li> <li>• Feed manufacturers – Use the pods to manufacture livestock feeds</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Baringo, Tana North and Taveta sub-counties
Counties where TIMP will be up scaled	West Pokot, Baringo, Lamu, Machakos, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate skills in ration formulation among producers</li> <li>• Labour intensive (harvesting and storage)</li> <li>• Negative attitude towards <i>P. juliflora</i> limits acceptance</li> </ul>
Recommendations for addressing challenges	<ul style="list-style-type: none"> <li>• Capacity build pastoral and agro-pastoral communities on feed formulation</li> <li>• Develop an efficient pod harvesting technique</li> <li>• Sensitization on use of <i>P. juliflora</i></li> </ul>
Lessons learned in up scaling if any	Successful adoption of <i>P. juliflora</i> requires availability of ready and consistent market for anticipated increased livestock production
Social, environmental, policy and market conditions	<ul style="list-style-type: none"> <li>• Farmers’ willingness to adopt <i>P. juliflora</i> as feed supplement to improve on productivity</li> </ul>

necessary for development and up scaling.	<ul style="list-style-type: none"> <li>• Favourable weather conditions to support biomass production</li> <li>• Availability of market for sale of increased production</li> <li>• Favourable policies to support marketing of improved livestock product</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 180 per animal for 3 months
Estimated returns	KES.736 (4.6 kg gain @ 160 per animal for three months)
Gender issues and concerns in development, , dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Slow flow of information and awareness for female farmers due to low levels education</li> <li>• Capacity building of women and youth on need to conserve and provide feeds for livestock throughout the year</li> <li>• Increased labour for women who are already overburdened may reduce their chance of adopting pasture and fodder technologies</li> <li>• Involvement of women and youth in harvesting and processing of <i>P. juliflora</i> stand a chance to register higher levels of adoption</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• High chance of adoption of technologies by women and youth who are mainly involved in collecting feeds for animals</li> <li>• Good business opportunity especially in the milling of seeds</li> <li>• Development of cottage industries by communities if technology is refined esp. the milling of <i>P. juliflora</i></li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may be disadvantaged in terms of lacking capital to establish milling plants</li> <li>• Capacity building of VMGs on need for conserved feeds to provide feed for livestock throughout the year</li> <li>• VMGs may be disadvantaged in terms of lacking capital to establish milling plants</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Business opportunity for VMGs since Pods are readily available and can be easily collected</li> <li>• More milk for VMGs from milk and goat sales</li> <li>• Availability of jobs and business opportunity especially in the milling</li> </ul>
Success stories from previous similar projects	<ul style="list-style-type: none"> <li>• Training on utilization of <i>Prosopis juliflora</i> as animal feed and charcoal briquettes in Mandera County, Kenya by Dr. Oscar Koech. <i>The participants were from Border Point one where 52 pastoralists were trained and Neboi area where 51 pastoralists were trained</i></li> <li>• <i>P. juliflora</i> flour been incorporated in commercial feeds e.g. Sigma Feeds</li> </ul>
Application guidelines for users	<ul style="list-style-type: none"> <li>• Kipchirchir, K. O., Kinuthia, N. R., &amp; Githaiga, W. R. (2014). Use of <i>Prosopis juliflora</i> Seedpod as Livestock Feed Supplement in the Arid and Semi-arid Rangelands of Kenya. In <i>Science, Policy and Politics</i></li> </ul>

	<p><i>of Modern Agricultural System</i> (pp. 197-209). Springer, Dordrecht.</p> <ul style="list-style-type: none"> <li>• Huho, J. M., &amp; Omar, M. H. (2020). <i>Prosopis Juliflora</i> In Asals Of Kenya: A Friend Or A Foe Plant. <i>Int. J. Sci. Res. Publ</i>, 10, 9968.</li> <li>• King'ori, A. M., Odero-Waitituh, J. A., &amp; Guliye, A. Y. (2011). Mathenge (<i>Prosopis juliflora</i>): An underutilized livestock feed resource in Kenya. <i>Research Journal of Animal Sciences</i>, 5(4-6), 43-51.</li> </ul>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	<ul style="list-style-type: none"> <li>• Ready for up scaling</li> <li>• Requires further research with respect to formulation of livestock finishing strategy in ASALs</li> </ul>
<b>G: Contacts</b>	
Contacts	<p>Institute Director  ARLRI Kiboko  P.O. Box 12 90138 Makindu, Kenya  <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a>  <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a>  +254 722289697</p>
Lead organization and scientists	<p>KALRO ARLRI Kiboko  Katiku P, Koror B K, Bii J c, Kuria S G</p>
Partner organizations	<p>MoALF&amp;C, County governments, Farmers' groups</p>



<b>TIMP Name</b>	<b>2.3.3 Cotton seedcake as supplementary feed for beef cattle</b>
<b>Category</b>	Management Practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low livestock production due to poor quality feed resulting in low beef supply. Poor access to market associated with low live weights resulting from poor quality feed
What is it? (TIMP description)	Cotton seed cake is a cheap industrial by-product rich in high protein (40.8%), energy (12.3 MJkg <sup>-1</sup> DM) content and ADF of 14.8%. It enhances feed intake thus increased weight gain
Justification	As supplementary feed ,rich in high protein and cheap compared to other commercial protein supplements, cotton seed cake, is a good for livestock farmers faced with challenges of low quality feed and less livestock productivity
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Agro-pastoralists and Pastoralists
Approaches to be used in dissemination	On farm demonstration, posters, conferences, field days

Critical/essential factors for successful promotion	Availability of financial resources to support dissemination activities, Availability of the cotton seed cakes
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• Cotton ginneries – providing the cakes</li> <li>• County governments – training the farmers, facilitating farmers to access the cakes</li> <li>• MoALF&amp;C – training extension staff, farmers</li> <li>• Farmers – applying the TIMP to improve livestock productivity</li> <li>• KALRO and other research organizations-Further Research</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	None
Counties where TIMP will be up scaled	Kitui, Taita Taveta
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Limited extension providers</li> <li>• Poor perception towards cotton seed cake</li> <li>• Cost of buying cotton seedcake</li> <li>• Inadequate skills in ration formulation</li> </ul>
Recommendations for addressing challenges	<ul style="list-style-type: none"> <li>• Support improved extension services</li> <li>• Campaign for attitude change</li> <li>• Provide initial support for buying cotton seed cake</li> <li>• Capacity building on ration formulation and use of cotton seed cake</li> <li>• Backstopping/facilitation of contact farmers as demonstration units</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Successful uptake of the technology requires availability of ready and consistent market for anticipated increased livestock production</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Favourable polices to support and improve cotton production locally, improve cotton producer prices, subsidize cotton production inputs</li> <li>• Policies to support livestock production, access to market and market prices</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	Feed cost per animal is KES. 351 for 3 months
Estimated returns	KES 2,400 (The animal gains 30 kg gain for three months, assuming live weight price of KES 80 per kg)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Slow flow of information and awareness for female farmers due to low levels education</li> <li>• Capacity building of women and youth on need to conserve and provide feeds for livestock throughout the year</li> <li>• Increased labour for women who are already overburdened may reduce their chance of adopting pasture and fodder technologies</li> </ul>

Gender related opportunities	<ul style="list-style-type: none"> <li>• High chance of adoption of technologies by women and youth who are mainly involved in collecting feeds for animals</li> <li>• Good business opportunity especially in the milling of seeds</li> <li>• Business opportunity for youth and women in fodder trade</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may be disadvantaged in terms of lacking capital to establish milling plants</li> <li>• Capacity building of VMGs on need for conserved feeds to provide feed for livestock throughout the year</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Business opportunity for VMGs since Pods are readily available and can be easily collected</li> <li>• VMGs can also harvest the Azolla and sell to users for money</li> <li>• Business opportunity for VMGs</li> <li>• More milk for VMGs from milk and goat sales</li> </ul>
<b>E: Case Studies/profiles of success stories</b>	
Success stories from similar previous projects	No on-farm experience.
Application guidelines for users	<ul style="list-style-type: none"> <li>• Bii J. C., S.A Abdulrazak<sup>2</sup>, E.A Mukisira<sup>3</sup> and E.K Shakala performance of the small east African zebu weaner cattle supplemented with <i>acacia tortilis</i> pods (available at ARLRI Kiboko).</li> <li>• Lengarite, M. I., Getachew, G., Akudabweni, L., &amp; Hoag, D. (2014). Supplementary feeding of lactating goats with processed and unprocessed Acacia tortilis pods and local grass in the dry season in northern Kenya. <i>Agricultural Science Research Journal</i>, 4(3), 63-71.</li> </ul>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling  Requires further research with respect to formulation of livestock finishing strategy in ASALs
<b>G: Contacts</b>	
<b>Contacts</b>	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
<b>Lead organization and scientists</b>	KALRO ARLRI Kiboko J C Bii, B K Korir, S G Kuria, P Katiku, J K. Manyeki
<b>Partner organizations</b>	County governments, Extension Agents, NGOs, feed manufacturers

## Gaps

1. Explore the cake as possible ingredient in the formulation of more balanced supplementary feed rations for finishing beef in ASALs. Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP

<b>TIMP Name</b>	<b>2.3.4 Cost effective feed conservation structure</b>
Category	Technology
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Loss of quality and quantity of conserved pastures due to poor storage
What is it? (TIMP description)	<p>A grass thatched or iron sheets roofed, cool, dry and well-ventilated store for storing livestock feeds in ASALs. The structure protects feed materials from weather elements, pests, stray domestic, animals, wild animals, and foreign materials.</p>  <p><i>Simple Hay barn (23 *21* 12 feet) for approx. 1000 bales</i></p>  <p><i>A barn full of hay at Sultan Hamud Estate, backstopped by KALRO Kiboko</i></p>
Justification	Poor storage of feed material results in deterioration of feed quantity and quality. Adoption of appropriate feed conservation structures help in conserving/keeping forage quality through dry period thus maintaining sustainable livestock production in the ASALS.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Agro pastoralists and pastoralists
Approaches to be used in dissemination	Training workshops, field demonstrations
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of pastures,</li> <li>• Availability of animals,</li> <li>• Availability of construction/building material</li> </ul>

Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• MoALF &amp; C to provide awareness and training</li> <li>• County governments to create awareness and training of farmers</li> <li>• NGOs to create awareness, community facilitation and mobilization</li> <li>• CBOs to mobilize individual farmers and farmer groups</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Agro pastoral and pastoral areas in Tana North, Marigat, Taveta, Turkana west Sub-counties
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate skills on farm feed conservation structures</li> <li>• Lack of funds to construct the structures</li> <li>• Unavailability of construction material</li> <li>• Negative attitude towards farm storage structure which limits acceptance,</li> </ul>
Suggestions for addressing challenges	<ul style="list-style-type: none"> <li>• Enhance awareness creation about the structure</li> <li>• Link micro finance institutions</li> <li>• Generate and make available funds, materials and labour for construction</li> <li>• Campaign for attitude change</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Successful adoption of construction of feed conservation structures requires availability of ready and consistent market for anticipated increased livestock/pasture production</li> <li>• Livestock feed storage structures need not be expensive</li> <li>• Changing climate is increasing urgency for adoption of feed conservation in ASALs</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Farmers' willingness to adopt and construct feed conservation structures to store quality feeds for use during off season period</li> <li>• Favourable weather conditions to support biomass production</li> <li>• Availability of market for sale of increased pasture /livestock production</li> <li>• Favourable policies to support marketing of increased availability of conserved feeds</li> <li>• Strong social structures to guard against theft of stored feeds</li> <li>• Availability of market for conserved pasture/feeds</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 150,000
Estimated returns	KES 75,000 (equivalent of 300 @ 250 bales which would have been lost without the barn)
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Slow flow of information and awareness for female farmers due to low levels education</li> <li>• Capacity building of women and youth on need to conserve and provide feeds for livestock throughout the year</li> </ul>

	<ul style="list-style-type: none"> <li>Increased labour for women who are already overburdened may reduce their chance of adopting pasture and fodder technologies</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>High chance of adoption of technologies by women and youth who are mainly involved in collecting feeds for animals</li> <li>Good business opportunity especially in the milling of seeds</li> <li>Business opportunity for youth and women in fodder trade</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>VMGs may be disadvantaged in terms of lacking capital to establish stores</li> <li>Capacity building of VMGs on need for conserved feeds to provide feed for livestock throughout the year</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>Business opportunity for VMGs since Pods are readily available and can be easily collected</li> <li>Business opportunity for VMGs</li> <li>More milk for VMGs from milk and goat sales</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
Application guidelines for users	<p>Oscar, K., &amp; Kibet, S. (2021). Pasture production and conservation training manual. <a href="https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/60747/1520ad77-4930-40df-9525-cfaad53aa1d9.pdf?sequence=1">https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/60747/1520ad77-4930-40df-9525-cfaad53aa1d9.pdf?sequence=1</a></p> <p>B.P. Ogillo, Elizabeth Muthiani and A. Ndathi. Hay making and storage for livestock production in arid and semi-arid areas. Available at ARLRI Kiboko</p>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	<p>Institute Director  KALROARLRI Kiboko  P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a>  <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a>  <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a>  +254 722289697</p>
Lead organization and scientists	<p>KALRO_ARLRI-Kiboko  Bryan P. Ogillo, Peter Mweki, John K. Manyeki, Bosco Kidake, Dennis Kubasu</p>
Partner organizations	County governments, CBO (KAPALIG), MoALF&C

### Research Gaps

- Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP

<b>TIMP Name</b>	<b>2.3.5 AZOLLA blended feeds for improved beef production and productivity</b>
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Category	Management Practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low livestock productivity(weight gain) due to poor quality feed
What is it? (TIMP description)	Azolla is nutritious plant that grows naturally in paddy rice fields, ponds, ditches and wetlands. It produces about 347 tons/ha of fresh material. Has high nutritive value (CP 18.8%), moderate energy (1759 kcal ME/kg), high DM digestibility (79.6%) and rich in trace minerals
Justification	Due to its high protein and low lignin content, Azolla is reported as one of the most economic and efficient feed substitutes for livestock. Azolla , improves feed quality thus enhancing livestock production
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Livestock keepers; Livestock feed manufacturers
Approaches to be used in dissemination	Field days, demonstrations
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Availability of <i>Azolla</i></li> <li>• Availability of labour</li> </ul>
Partners/stakeholders for scaling up and their roles	<p>Rice farmers – supplying the <i>Azolla</i></p> <p>County governments – training farmers on the TIMP</p> <p>Farmer groups – growing the <i>Azolla</i> outside paddy rice fields and supplying to livestock producers</p>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted	Practised in Muranga and Embu
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Poor perception towards adoption of <i>Azolla</i></li> <li>• Limited extension providers</li> </ul>
Suggestions for addressing challenges	<ul style="list-style-type: none"> <li>• Campaign for attitude change</li> <li>• Support extension services</li> </ul>
Lessons learned in up scaling if any	Successful Adoption of <i>Azolla</i> blended feed requires availability of ready and consistent market for anticipated increased livestock production
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Farmers' willingness to adopt <i>AZOLLA</i> as feed supplement to improve on productivity</li> <li>• Favourable weather conditions to support biomass production</li> <li>• Availability of market for sale of increased production</li> <li>• Favourable policies to support marketing of improved livestock product</li> </ul>

<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES.1080 in labour cost to collect and dry a ton from rice fields
Estimated returns	KES 4400 extra income per animal since the animal gains 9.8 kg for three months at a cost of @450 per kg
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Slow flow of information and awareness for female farmers due to low levels education</li> <li>• Capacity building of women and youth on need to conserve and provide feeds for livestock throughout the year</li> <li>• Increased labour for women who are already overburdened may reduce their chance of adopting pasture and fodder technologies</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• High chance of adoption of technologies by women and youth who are mainly involved in collecting feeds for animals</li> <li>• Business opportunity for youth and women in fodder trade</li> <li>• Men and youth can harvest Azolla and sell to other dairy farmers</li> <li>• The youth are likely to embrace the new technologies based on their novelty</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Capacity building of VMGs on need for conserved feeds to provide feed for livestock throughout the year</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Business opportunity for VMGs since Pods are readily available and can be easily collected</li> <li>• VMGs can also harvest the Azolla and sell to users for money</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Training on how to culture and use Azolla as feed supplement has been done in farms located at Maragwa Ridge, Murang'a County and at Kamulu, Nairobi County 0714545454
Application guidelines for users	Jain, R., Jain, G., & Singh, N. J. (2019). Azolla: An alternate fodder supplement in livestock feed. <i>Innovations in agriculture, environment and health research for ecological restoration</i> , 24-253.
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Requires further research to determine the production potential when grown outside paddy fields
<b>G: Contacts</b>	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697

Lead organization and scientists	KALRO ARLRI Kiboko Mr. Korir, R K; Bii J C, Kuria S G, Katiku P
Partner organizations	County governments, MoALF&C, farmer groups

## Research gaps

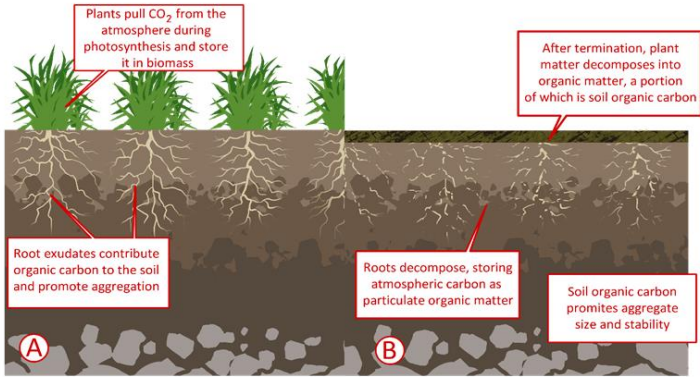
1. Need to understand effect of harvesting the Azolla on rice yield
2. Need to test growing the Azolla outside the paddy rice fields
3. Proper cost benefit analysis needed.

## 2.4 Pastoral and Agro-pastoral Information System

TIMP Name	2.4.1 Matching livestock production with the market needs
Category	Management practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low livestock productivity
What is it? (TIMP description)	It is the appreciation of market requirements for cattle and shoats by producers and the use of this information in matching production of animals to market demands. Producers need to understand the age, size, entire or castrates and quality of milk among other specifications of the livestock demanded by the consumers in order to produce for sale and not to sell.
Justification	Mismatch between supply and demand of beef, sheep and goat meat due to inadequate production and market planning leading to market failure'. Addressing the causes of market failure requires an understanding of the market and targeted production to meet the observed market needs.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Pastoralists and agro-pastoralists rearing cattle, sheep and goats
Approaches to be used in dissemination	Field days , shows and conferences
Critical/essential factors for successful promotion	<ul style="list-style-type: none"> <li>• Commercial orientation livestock production in pastoral and agro-pastoral systems</li> <li>• Knowledge on factors of supply and demand, finished animals for sale and livestock traders</li> </ul>
Partners/stakeholders for scaling up and their roles	<ul style="list-style-type: none"> <li>• County governments – training farmers</li> <li>• MoALF&amp;C – training extension staff, funding dissemination activities</li> <li>• Farmers – applying the information to produce for markets</li> <li>• KMC – buy livestock from farmers</li> </ul>

	<ul style="list-style-type: none"> <li>• KLMC – Source for livestock markets for farmers and lobby for good prices, link farmers to the markets</li> </ul>
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni and Kajiado counties
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate extension information on export/local market requirements for cattle and shoats</li> <li>• High illiteracy levels of pastoralists</li> <li>• Farmers willingness to adopt</li> </ul>
Suggestions for addressing challenges	<ul style="list-style-type: none"> <li>• Support extension information on production and market requirements</li> <li>• Capacity build pastoralists on livestock production and market structures to enhance adoption</li> </ul>
Lessons learned in up scaling if any	Need to package and share current information on different livestock market quality requirement/ standards
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Farmers’ willingness to adopt and produce livestock depending on market needs</li> <li>• Availability of market to sell increased livestock products</li> <li>• Favourable marketing policies for livestock products</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES 16,000 cost of rearing one animal
Estimated returns	KES 32,000 sale per animal
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Women and youth do not livestock</li> <li>• Capacity building of women and youth marketing of livestock</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• High chance of adoption of technologies by women and youth who are mainly involved in collecting feeds for animals</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs may be disadvantaged in terms of lacking capital to marketing of livestock</li> <li>• Capacity building of VMGs market linkages</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Business opportunity for VMGs in marketing of livestock</li> <li>• Current and adequate market information enable the VMGs to sufficiently participate in the market</li> </ul>

<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	None
<b>Application guidelines for users</b>	Not done
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
<b>Contacts</b>	Institute Director KALRO-ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
<b>Lead organization and scientists</b>	KALRO, ARLRI-Kiboko Mr. John Manyeki, Janet Kimutai
<b>Partner organizations</b>	County governments, MoALF&C


<b>TIMP Name</b>	<b>2.4.2 Carbon sequestration in grasslands ecosystems</b>
Category	Technology
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	High carbon dioxide accumulation in the atmosphere due to less biomass which is a potential carbon capture and sinks
What is it? (TIMP description)	<p>Grass pastures capture carbon dioxide from the atmosphere during photosynthesis process and store it in carbon pools (roots). This help in mitigating carbon dioxide concentration in the atmosphere</p>  <p>Role of grass in the carbon cycle (source: <a href="https://theconversation.com/amp/restoring-soil-can-help-address-climate-change-121733">https://theconversation.com/amp/restoring-soil-can-help-address-climate-change-121733</a>)</p>

Justification	As a potential carbon sink, grass pastures help in mitigating carbon dioxide concentration in the atmosphere thus offsetting climate change impacts
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Range managers, County governments, NGOs, institutions involved in climate change issues, environmental organizations, policy makers
Approaches to be used in dissemination	Community feedback meetings, mass media, farmer field days
Critical/essential factors for successful promotion	Strong support by county governments, universities, NGOs and CBOs involved in environmental conservation
Partners/stakeholders for scaling up and their roles	County governments – Training farmers on the TIMP  Research organizations– Create awareness about the TIMP  National Drought Management Authority – assist farmers access carbon credit
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Southern Ethiopia and Northern Kenya
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Poor perception limiting uptake</li> <li>• Limited extension providers</li> <li>• Low literacy level limiting understanding and application among ASAL communities</li> </ul>
Suggestions for addressing challenges	<ul style="list-style-type: none"> <li>• Campaign for attitude change</li> <li>• Support improved extension services</li> <li>• Capacity building of community members</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Successful grass pasture establishment and promotion requires availability of ready and consistent market for anticipated increased pasture production</li> <li>• Rangeland ecosystems are important in climate change mitigation through carbon absorption and it is important to properly conserve them.</li> <li>• Production systems can be tailored to meet both livestock demands as well as environmental conservation.</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Farmers willingness</li> <li>• Favourable weather conditions to support biomass production</li> <li>• Available markets</li> <li>• Favourable policies to support grass pasture establishment, marketing and control rangeland degradation</li> </ul>

<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	KES. 35,000/ha; USD389/ha
Estimated returns	KES 73,500 (49 carbon dioxide equivalent @1500 per acre per year )
Gender issues and concerns in development, dissemination, adoption and scaling up	• Target both men and women in scaling up to ensure that the degraded grassland ecosystems are rehabilitated
Gender related opportunities	The technology motivates men, women and youth to rehabilitate degraded rangelands not only for climate change mitigation but also for improved livestock productivity
VMG issues and concerns in development, dissemination, adoption and scaling up	Low literacy level is a big problem among the VMGs. This low literacy in VMGs adversely affects adoption.
VMG related opportunities	The technology motivate VMGs to rehabilitate degraded rangelands not only for climate change mitigation but also for improved livestock productivity
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	The Northern Kenya Grassland Carbon Project -the world's first large-scale grasslands soil carbon project anticipated to remove and store over 50 million tons of CO2 equivalent over 30 years
Application guidelines for users	The Northern Kenya grassland Carbon project implementation documents and report
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling but the Cost benefit analysis information should be generated
<b>G: Contacts</b>	
Contacts	Institute Director KALRO- ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Mr. Bosco Kidake, Bryan Ogillo, Annastacia Maweu
Partner organizations	County governments, MoALF&C, farmer groups

## Research Gaps

- Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP

<b>TIMP Name</b>	<b>2.4.3 Utilization of traditional indicators for weather prediction in pastoral and agro-pastoral systems</b>
Category	Management practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Limited coverage of the conventional weather forecast information
What is it? (TIMP description)	<p>It is the use of specific plants (e.g. Baobabs, Acacias, Commiphora) as traditional indicators used to forecast weather and therefore enhance planning on use of resources by the communities. The shedding of leaves indicates beginning of drought while formation of new leaves indicates that the rainy season is near</p>  <p><i>Baobab tree used a weather indicator</i></p>
Justification	The availability of weather stations in pastoral and agro-pastoral systems is limited and inadequate. On the other hand, there is high temporal and spatial variability of weather in pastoral and agro-pastoral system. This has led to the communities to rely on tried and tested traditional knowledge on weather prediction which is readily available compared to the modern weather forecasting.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Agro pastoralists and Pastoralists
Approaches to be used in dissemination	Feedback meetings, Community meetings and Bulletins
Critical/essential factors for successful promotion	Community understanding of indicators in their respective areas
Partners/stakeholders for scaling up and their roles	Meteorology – validation of the ITK NGOs, CBOs – funding training of extension staff
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Baringo, Tana North, Taveta, Kenya, Yabello in Ethiopia, North West Tanzania
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate institutionalization</li> <li>• Effects of climate change on indicators</li> </ul>

	<ul style="list-style-type: none"> <li>• Increasing settlements and cultivation leading to loss of the indicators</li> <li>• Cost of receiving and using inaccurate information not determined</li> </ul>
Suggestions for addressing challenges	<ul style="list-style-type: none"> <li>• Institutionalization</li> <li>• Development of database and continuous monitoring of the indicators</li> <li>• Need to conserve the indicators through live herbarium etc.</li> <li>• Estimate cost of wrong forecast</li> </ul>
Lessons learned in up scaling if any	<ul style="list-style-type: none"> <li>• Communities in the ASALs consider traditional indicators more reliable</li> <li>• Some communities depend only on traditional indicators for weather forecasting</li> <li>• ITK knowledge is getting lost due to religious, education and generational change</li> <li>• Some communities have seers for weather forecasting</li> </ul>
Social, environmental, policy and market conditions necessary for development and up scaling	<ul style="list-style-type: none"> <li>• Acknowledgement and respect for indigenous technical knowledge (ITK) is a critical policy issue</li> <li>• Seers perceived as witches which may discourage them from releasing the information</li> <li>• Conservation of the indicators has a positive bearing on environmental integrity</li> </ul>
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	No costs (just need to observe the plants)
Estimated returns	Gains by knowing right time to plant enabling harvest
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Most of the youth disregard the Indigenous Technical Knowledge (ITK).</li> <li>• ITK is a domain for only a few aged men and women</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Create awareness to the youth on how to identify with the ITK for sustainable resource use and conservation</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Readily available for use by VMGS</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Can use the knowledge to improve livestock and crop production</li> <li>• ITK can be tapped from VMGs, documented, published and the books used to generate income</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Tana North experience where the community have one elder known across the Orma community as the seer on weather forecasting and it works
Application guidelines for users	Musembi, D. K., & Cheruiyot, H. K. (2016). A case for validation of indigenous knowledge in forecasting rainfall among the Kamba community of Makueni

	county, lower Eastern Kenya. <a href="http://repository.seku.ac.ke/handle/123456789/2887">http://repository.seku.ac.ke/handle/123456789/2887</a>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling, However, validation of the ITK and proper documentation is necessary
<b>G: Contacts</b>	
Contacts	Institute Director KALRO- ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	KALRO-ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu South Eastern Kenya University (SEKU) Dr. David K Musembi
Partner organizations	SEKU, TALIRI, MABUKI Tanzania and OARI, Yabello , Ethiopia

## Research gaps

The ITK requires validation and proper documentation

<b>TIMP Name</b>	<b>2.4.4 Socio economics of reseeding rangelands in Kenya</b>
Category	Management practice
<b>A: Description of technology, innovation or Management practice</b>	
Problem to be addressed	Low adoption; social and economics (gross margin and cost benefit ratio) of improving natural pastures
What is it? (TIMP description)	It is the analysis of total costs for rangeland reseeding activities and benefits that comes with reseeding for purposes of determining profitability of the activity. This analysis gives confidence and assure potential investors in NAPI through reseeding of positive returns.
Justification	High demand for forage improvement materials, Low adoption of reseeding technology, Inadequate information on socioeconomic of reseeding, Lack of elaborate marketing systems of natural pasture products, Low priority given to range management and sown pasture by farmers and the government.
<b>B: Assessment of dissemination and scaling up/out approaches</b>	
Users of TIMP	Research/University institutions Agro pastoralists and pastoralists
Approaches to be used in dissemination	Training and feedback workshops
Critical/essential factors for successful promotion	

Partners/stakeholders for scaling up and their roles	MoALF&C – Training of county extension staff, funding the dissemination activities County governments – training farmers NGOs, CBOs – training farmers, facilitate training of extension staff
<b>C: Current situation and future scaling up</b>	
Counties where already promoted if any	Makueni, Taita Taveta, Kajiado
Counties where TIMP will be up scaled	West Pokot, Baringo, Laikipia, Machakos, Lamu, Taita Taveta, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	<ul style="list-style-type: none"> <li>• Inadequate quantity of range grass seed</li> <li>• Informal marketing of grass seed</li> </ul>
Recommendations for addressing challenges	Linking to KEPHIS for seed certification
Lessons learned in up scaling if any	Intensive training on NaPI technologies, provision of grass seed and field days are crucial for success of NaPI
Social, environmental, policy and market conditions necessary for development and up scaling	All gender involvement Formal market for range grass seed
<b>D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations</b>	
Basic costs	Average KES 12,625.58 per hectare
Estimated returns	Average KES 94,052.10 per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• Limited access to land for pasture production by youth and women</li> <li>• Limited access to lack funds to acquire required inputs such as planting materials</li> <li>• Access to land and funds may limit the technology to women</li> <li>• Women and youth may not manage to raise the high start-up capital for irrigation infrastructure and other inputs</li> <li>• Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks</li> </ul>
Gender related opportunities	<ul style="list-style-type: none"> <li>• Seed bulking is a source of household income when the seeds are sold and income shared among members</li> <li>• There are affirmative action opportunities for women and youths to acquire required credit</li> <li>• There are employment opportunities for the youth and women</li> <li>• Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend</li> </ul>
VMG issues and concerns in development, dissemination, adoption and scaling up	<ul style="list-style-type: none"> <li>• VMGs lack funds to acquire required inputs</li> <li>• VMGs have limited access to agricultural information, technology and knowledge</li> </ul>

	<ul style="list-style-type: none"> <li>• Slow information and awareness flow to VMGs due to low academic levels</li> <li>• VMGs may not be able to reach far way markets or have bargaining power</li> <li>• VMGs may be excluded from decision making during dissemination because of their social status</li> <li>• Lack of awareness by VMGs will lead to low adoption of pastoral and agro-pastoral seed systems technologies</li> </ul>
VMG related opportunities	<ul style="list-style-type: none"> <li>• Increased livestock productivity is expected to improve the diets and incomes of VMGs</li> <li>• Income generation through production and sale of products</li> </ul>
<b>E: Case studies/profiles of success stories</b>	
Success stories from previous similar projects	Not documented
Application guidelines for users	Manyeki J K, Kirwa E C, Ogillo P B, Mnene W N, Kimitei R, Mosu A and Ngetich R 2015: Economic analysis of natural pasture rehabilitation through reseeded in the southern rangelands of Kenya. Livestock Research for Rural Development. Volume 27, Article #49. Retrieved November 4, 2022, from <a href="http://www.lrrd.org/lrrd27/3/many27049.html">http://www.lrrd.org/lrrd27/3/many27049.html</a>
<b>F: Status of the TIMP readiness</b> (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling
<b>G: Contacts</b>	
Contacts	Institute Director. KALRO ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya <a href="mailto:directorarlri@kalro.org">directorarlri@kalro.org</a> <a href="mailto:simon.kuria@kalro.org">simon.kuria@kalro.org</a> <a href="mailto:Kuriasg@gmail.com">Kuriasg@gmail.com</a> +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Manyeki J K Cell: +254 714204584; Kimutai Janet Cell: +254 725509145
Partner organizations	County governments, CBOs e.g. (KAPALIG), MoALF&C

#### Research Gaps

- Cost/benefit analysis of community based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP



Kenya Climate Smart  
Agriculture Project

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

[www.kalro.org](http://www.kalro.org)