KALRO
Kenya Agricultural & Livestock Research Organization

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

Inventory of Climate Smart Agriculture Technologies, Innovations and Management Practices for Dairy Cattle Value Chain









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

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FOREWORD

The Kenya Agricultural and Livestock Research Organization (KALRO) through the support of development partners has laid a strong foundation for growth and commercialization of agriculture in Kenya. This has been done through the development of Climate Smart Technologies, Innovations and Management Practices (TIMPs) through the adaptive and applied research guided by some of the research gaps identified earlier. In addition, the organization has embraced an interconnected information communication technology to ease the handling of data and information from research. A notable inclusion is the use of the Big Data Platform to integrate digital information from value chains. The National Agricultural Value Chain Development Project (NAVCDP) seeks to build on and deepen investments into interventions on productivity enhancement, community-led farmer extension, water management investments and data-driven value chain services from KCSAP and NARIGP previous projects. In this NAVCDP project, KALRO seeks to strengthen, customize and update the existing inventories of TIMPs, with emphasis on climate resilience, safer food production practices, value addition, nutrition, market participation and commercialization.

With the continued support, KALRO also is poised to continue providing quality technical assistance for value chain development at all levels and build capacity of county level implementation units to anchor project activities. With the support of NAVCDP, KALRO has developed inventories of TIMPs for the two new value chains, pyrethrum and rice and is continuously expanding, updating and revising existing inventories of TIMPs. In doing so, KALRO further strengthens climate resilience, value addition and market participation aspects of the updated TIMPs to support farmers to transition from subsistence to commercial farming. The organization continues to support the strengthening of the current Big Data platform at KALRO as the foundational database for insight-driven, more productive, resource efficient and climate-resilient farming. To enhance the effective coordination of research linkages and agriculture digitization, KALRO and the Ministry of Agriculture and Livestock Development have put in relevant support mechanisms to oversee the implementation of these activities.

Extensive information from research and background data has been used to develop this revised Inventory of TIMPs for the Cashew Value chain. 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 a 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 the achievement of the Project Development Objective (PDO), which is to increase market participation and value addition for targeted farmers in select value chains in project areas. This revised TIMPs inventory is to be used in conjunction with the respective ToT Manual.

Finally, I am greatly indebted to the value chain leaders and all those who participated in the preparation and revision of this Inventory of TIMPs for the Dairy Value Chain. 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 National Agricultural Value Chain Development Project (NAVCDP) is a Government of Kenya project with support from the World Bank. The five-year project is being implemented in 34 counties clustered in seven regions at an approximate cost of U$ 275 million. The project development objective (PDO) is "increase market participation and value addition for targeted farmers in select value chains in project areas." It is expected that this objective will be achieved through implementing the five project components, namely; Building Producer capacity for climate resilient stronger value chains; Climate Smart Value Chain Ecosystem Investments; Piloting Climate Smart Safer Urban Food Systems; Project Coordination and Management; and Contingent Emergency Response Component.

The National Agricultural Value Chain Development Project aims to support 3.8 million small-scale farmers transitioning from subsistence to commercial farming, or are selling only a small percentage of their produce commercially. Additional beneficiaries of the Project include value chain actors at various levels, the extension workers, aggregators, logistics support providers and SMEs operating within the value chain. The Project places a strong focus on inclusion of women farmers within the supported Value Chains (VCs). Thirteen VC's have been selected based on a thorough qualitative and quantitative assessment of their potential. The selected VCs based on their ranking are Dairy, Chicken, Coffee, Avocado, Banana, Mango, Irish potatoes, Tomato, Apiculture, Pyrethrum, Cashew nut, Cotton and Rice. Additional value chains prioritized by counties will be supported by their respective County Project Coordination Units.

The National Agricultural Value Chain Development Project has partnered with KALRO to continue strengthening and expanding the existing inventory of TIMPs with an emphasis on climate resilience, value addition, nutrition, and safer food production practices. Through this partnership, KALRO has developed Technologies, Innovations and Management Practices (TIMPs) inventories for the two new value chains - Rice and Pyrethrum, and revised existing inventories of TIMPs for all other value chains developed during the implementation of KCSAP and NARIGP. It also supports the strengthening of the existing Big Data platform at KALRO as the foundational database for insight-driven, more productive, resource-efficient and climate-resilient farming. Finally, the Ministry of Agriculture, Livestock Development (MoALD) has put in place relevant support mechanisms with KALRO to oversee effective implementation, coordination of research linkages and agriculture digitization.

In developing suitable inventories of TIMPs and corresponding ToT manuals, KALRO has leveraged information resources as well as those of its partners and collaborators. Use of these information resources, coupled with the accompanying training and contribution of the other project components, will go a long way in enabling NAVCDP to meet its development objectives.

The National Project Coordination Unit is grateful to all who participated in the development and production of this revised Inventory of TIMPs for Dairy 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.

Samuel Guto, PhD
National Project Coordinator
National Agricultural Value Chain Development Project

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ABBREVIATIONS AND ACRONYMS

AKEFEMA	Association of Kenya feed manufacturers
AI	Artificial insemination
AIP	Agricultural innovation platforms
APSK	Animal Production Society of Kenya
ARLRI	Arid and Rangelands Research Institute
ART	Assisted Reproductive Technologies
ASALs	Arid and Semi-Arid Lands
ASK	Agricultural Society of Kenya
BECA	Bio Science Eastern and Central Africa
BETA	Bottom up Economic Transformation Agenda
BioRI	Biotechnology Research Institute
BOD	Biological oxygen demand
BSF	Black Soldier Fly
BW	Body weight
CA	Conservation Agriculture
CBOs	Community based organization
CCPP	Contagious caprine pleuropneumonia
CF	Crude Fibre
CGIAR	Consultative Group for International Agricultural Research
CHROX	Chloris roxburghiana
CIG	Common Interest Group
COD	Chemical Oxygen Demand
COMESA	Common markets for East and southern Africa
CP	Crude Protein
CSA	Climate Smart Agriculture
DRI	Dairy Research Institute
EAC	East African Community
ERC	Energy Regulatory Commission
EMCA	Environmental Management Coordination Act

ENMA	Enteropogon macrostachyus
ERSU	Eragrostis superba
DGAK	Dairy Goats Association of Kenya
DGBA	Dairy Goats breeders association
DIVA	Differentiating Vaccine
DLPO	Director Livestock Production Office
DM	Dry matter
DVS	Director of Veterinary Services
EAAPP	East African Agricultural and Productivity Project
FBO	Farmer Based Organization
FFBS	Farmer Field and Business School
FFS	Farmer Field School
FMD	Foot and Mouth Disease
FSMS	Food Safety Management System
GAP	Good Agricultural Practice
GHG	Green House Gas
GTZ	German Technical Corporation
HACCP	Hazard Analysis and Critical Control Points
HAC	High Altitude Composite
HIVOS	Humanist Institute for Development Cooperation
HPI	Heifer Project International
ICIPE	International Centre of Insect Physiology and Ecology
ICM	Integrated Crop Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information Communication Technology
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IPM	Integrated Pest Management
ISDA	Innovative Solution for Decision Agriculture
JKUAT	Jomo Kenyatta University of Science and Technology

KAGRC	Kenya Animal Genetics Resources Centre
KAK 1/2/3	Kakamega 1, 2 and 3
KALPRO	KALRO Probiotics
KALRO	Kenya Agricultural and Livestock Research Organization
KAPALIG	Kavatini Pastoralists Livestock Improvement Group
KBK	Kiboko
KBP	Kenya Biogas Programme
KCSAP	Kenya Climate-Smart Agriculture Project
KDB	Kenya Dairy Board
KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forestry Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KES	Kenya Shillings
KEVEVAPI	Kenya veterinary vaccines production institute
KIOF	Kenya Institute of organic farming
KIRDI	Kenya Industrial Research & Development Institute
KLBA	Kenya Livestock Breeders Association
KMGBA	Kitui Mwingi Goat Breeders association
KENBIM	Kenya National Domestic Biogas Programme
KWFT	Kenya Women Finance Trust
LAB	Lactic Acid Bacilli
LBW	Live Body Weight
LH	Lower Highlands
LSD	Lumpy Skin Disease
MGBA	Meru goat breeders association
MGD	Magadi
MoALD	Ministry of Agriculture & Livestock Development
MSD	Maize silage supplemented with dairy meal
MSL	Maize silage supplemented with lupin seed-based concentrates
MSP	Maize silage supplemented with poultry waste-based concentrates

MSMEs	Micro, Small and medium enterprises
NACl	Sodium Chloride
NARI	National Agricultural Research Institute
NALIRRI	National Livestock Resources Research Institute
NARS	National Agricultural Research Systems
NAVCDP	National Agricultural Value Chain Development Project
NAMA	Nationally Appropriate Mitigation Action
NDA	National Designated Authority
NDDP	National Dairy Development Project
NDGFA	Nyanza Dairy Goat Farmers Association
NGO	Non-Governmental Organization
NPT	National Performance Trials
PCPB	Pest Control Products Board
PTRE	Phytochemicals textiles and renewable energy
RD	Rhodes grass hay supplemented with dairy meal concentrates
RL	Rhodes grass hay supplemented with lupin seed-based concentrate
RP	Rhodes grass hay supplemented with poultry waste-based concentrate
SEAZ	Small East African Zebu
SCODE	Sustainable Community Development Services
SDCP	Smallholder Dairy Commercialization programme
SDL	State Department for Livestock
SNV	Netherlands Development Organisation
SPV	Sweet Potato Vines
TDS	Total dissolved solids
TIMPs	Technologies, Innovation and Management Practices
TMR	Total Mixed Rations
TNGB	Tharaka Nithi Goat breeders
ToT	Training of Trainer
TVT	Taveta
USD	United States Dollars

USSD	Unstructured Supplementary Service Data
VC	Value Chain
VMGs	Vulnerable and Marginalized Group

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

1.1 Definition of terms

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

Management practice: This is defined as recommendation(s) on practice(s) that is/are considered necessary for a technology to achieve its optimum output. These include, for instance, different agronomic 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 that 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 existing technology for an entirely different use from the original intended use. (e.g. fireless cooker modified to be used as a hatchery)

DAIRY CATTLE

1.2 Summary of Inventory of TIMPs in the Dairy Value Chain

The inventory process resulted in a total of 57 TIMPs including 47 technologies, 2 innovations and 8 management practices, distributed among the 8 sub-themes, as indicated in Table 1.

Table 1: Summary of dairy TIMPs

Commodity/ VC	Sub-Theme	Technologies	Innovations	Management Practices
Dairy	Cattle Breeding and Improvement	3	10	12
Dairy	Feeds and Feeding	13	0	0
Dairy	Forage production	6	1	1
Dairy	Feed formulation	7	0	0
Dairy	Value addition	7	0	0
Dairy	Manure management for bio energy	1	0	32
Dairy	Dairy Cattle Health Management	18	0	03
Dairy	Dairy commercialization, marketing and policy options	0	0	3
Overall Total		**47**	**2**	**8**

1.3 Summary of Status of TIMPs in Dairy Value Chain

The inventory process resulted in a total of 43 TIMPs that are ready for upscaling, 13 TIMPs that require validation and 1 TIMPs that require further research in the sub-themes, as indicated in Table 2.

Table 2: Number of TIMPs ready for upscaling, require validation or further research

Commodity/VC	Sub-Theme	Ready for upscaling	Require validation	Further Research
Dairy	Cattle breeding and improvement	5	0	0
Dairy	Feeds and feeding	12	1	0
Dairy	Pasture and Fodder	3	5	0
Dairy	Feed formulation	6	1	0
Dairy	Milk value addition	7	0	0
Dairy	Manure management management for bioenergy	3	0	0
Dairy	Dairy Cattle Health Management	74	36	1
Dairy	Dairy cattle commercialization, marketing and policy options	3	0	0
Overall Total		**43**	**13**	**1**

*Requires further research/validation

Table 3: Inventory of Dairy TIMPs by Category and Status

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.1 Cattle breeding and improvement	2.1.1 Assisted Reproductive Technique-FTAI	Technology	eady for upscalingvalidation
	2.1.2 Assisted Reproductive Technique using Sahiwal germplasm	Technology	Ready for upscaling
	2.1.3 Dairy cattle selection and crossbreeding	Management practice	Ready for upscaling/
	2.1.4 Friesian Sahiwal Crossbreed	Technology	Ready for Upscaling
	2.1.5 Community based breeding programme	IManagement practice	Ready for upscaling
2.2 Feeds and feeding	2.2.1 Improved Napier grass varieties (Kakamega 1, 2, and 3; Ouma; South Africa)	Technology	Ready for upscaling
	2.2.2 Oats for dairy production in frost prone areas	Technology	Ready for upscaling
	2.2.3 High altitude composite maize fodder	Technology	Ready for upscaling
	2.2.4 Fodder sorghum (*Sorghum bicolor*) variety- E6518	Technology	Ready for upscaling
	2.2.5 Climate smart Brachiaria grass	Technology	Ready for upscaling
	2.2.6 Common vetch – *Vicia sativa* fodder	Technology	Ready for upscaling

	2.2.7 Desmodium (*Desmodium intortum*)- Napier grass intercrop	Technology	Ready for upscaling
	2.2.8 Cassava based Napier grass silage	Technology	Ready for upscaling
	2.2.9Tree Lucerne or tagasaste- *Chamaecytisus prolifer*	Technology	Ready for upscaling and validation
	2.2.10 Sweet lupin (*Lupinus albus* and *Lupinus angustifolius*)	Technology	Ready for upscaling and validation
	2.2.11 Sweet potato vines	Technology	Ready for upscaling
	2.2.11	T	R
	2.2.12 Napier grass and gliricidia leaves silage	Technology	Ready for upscaling
	2.2.13 Oat/Napier- vetch intercrop	Technology	Require validation
2.3 Forage production	2.3.1 Community based range grass seed bulking	Management practice	Ready for upscaling
	2.3.2 Buffel grass (*Cenchrus ciliaris*) var. MGD-1	Technology	Require validation
	2.3.3 Buffel grass (*Cenchrus ciliaris*) var. TVT-3	Technology	Require validation
	2.3.4 Bushrye grass (*Enteropogon macrostachyus*) var. **ENMA-KBK**	Technology	Require validation
	2.3.5 Horsetail grass (*Chloris roxburghiana*) var. **CHROX-KBK**	Technology	Require validation
	2.3.6 Maasai Love Grass (*Eragrostis superba*) var. ERSU-1	Technology	Require validation
	2.3.7. Zero grazing Unit	Innovation	Ready for upscaling
	2.3.8 Dairy calf feeding regime	Management practice	Ready for upscaling
2.4 Feed formulation	2.4.1 Feed rations formulation	Technology	Ready for upscaling
	2.4.2 Early weaning milk replacer diet	Technology	Ready for upscaling
	2.4.3 Maize silage based total mixed rations (TMR) for weaner dairy calves	Technology	Requires validation
	2.4.4 Maize silage and lupin-based TMR for lactating cows	Technology	Ready for upscaling
	2.4.5 Rhodes grass hay and lupin based TMR for lactating dairy cows	Technology	Ready for upscaling
	2.4.6 Improved Probiotics for dairy cattle (KALPRO)	Technology	Ready for upscaling
	2.4.7 Crop Residue based Total Mixed Ration (TMR)	Technology	Ready for upscaling
2.5 Value addition	2.5.1 Pasteurized dairy cattle milk	Technology	Ready for upscaling
	2.5.2 Cattle Yoghurt	Technology	Ready for upscaling
	2.5.3 Cattle *Maziwa lala*	Technology	Ready for upscaling
	2.5.4 Cheese	Technology	Ready for upscaling
	2.5.5 Butter	Technology	Ready for upscaling
	2.5.6 Ghee	Technology	Ready for upscaling
	2.5.7 Wet salting of raw hides and skins	TManagement practice	Ready for upscaling

2.6. Manure management for bioenergy	2.6.1 Domestic biogas	MTechnology	Ready for upscaling
	2.6.2 Bio degradation of manure using BSF	Management practice	Ready for upscaling
	2.6.3 Bio slurry utilization for soil improvement	Management practice	Ready for upscaling
2.7 Dairy Cattle Health Management	2.7.1. Theileria parva Marikebuni East Coast Fever (ECF) vaccine	Technology	Ready for up-scaling
	2.7.2. Contagious Bovine Pleuro-pneumonia (CBBP) DIVA Vaccine	Technology	Requires field validation
	2.7.3. Recombinant HC58 DNA Vaccine	Technology	Require further research
	2.7.4 Integrated Helminth Control	TManagement Practice	RReady for upscaling
	2.7.5. Push-Pull for tsetse fly control	Technology	Requires field validation
	2.7.6. Protocol for Controlling Mastitis in Dairy Animals	Technology	RRequires validation
	2.7.7. Oil-Based Foot and Mouth Disease (FMD) Vaccine	MTechnology	RRequires validation
	2.7.8 Protocol for Production of Contaminant-free Milk	Management practice	Ready for up-scaling
	2.7.9. Protocols for Reducing Infertility in Dairy Animals	Management practice	Ready for up-scaling
	2.7.10 Protein tagged Latex Agglutination Test for Contagious Bovine Pleuro-pneumonia	Technology	Requires validation
	2 2.7.11 Sub-unit Contagious Bovine Pleuro-pneumonia (CBPP) Vaccine	Technology	RRequires validation
2.8 Dairy cattle Commercializatio n, Marketing and Policy Options	2.8.1 Dairy commercialization	Management practice	Ready for upscaling
	2.8.2 Dairy Marketing	Management practice	Ready for upscaling
	2.8.3 Dairy Policy options and regulations	Management practice	Ready for upscaling
*All the TIMPs described below are ready for upscaling. However, Gaps have been identified to fine tune them either through validation in other counties or further research			

2.0 Detailed Dairy Cattle Value Chain Timps

2.1 Cattle Breeding and Improvement

2.1.1 Assisted Reproductive Technique – Fixed Time Artificial Insemination (FTAI)

2.1.1 TIMP name	**Assisted Reproductive Technique – Fixed Time Artificial Insemination (FTAI)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Fixed-time artificial insemination (FTAI) addresses several problems in animal reproductive management, particularly in livestock such as cattle. Some key problems that FTAI helps to address include: traditional artificial insemination relies on detecting when females are in estrus (heat), which can be labor-intensive and prone to errors, variability in heat detection accuracy and timing can lead to suboptimal insemination times and lower conception rates, irregular calving intervals can disrupt production schedules and affect overall herd productivity and inconsistent breeding schedules and missed heats can slow genetic progress in the herd.
What is it? (TIMP description)	Fixed Time Artificial Insemination (FTAI) is a hormonal treatment of the cows/heifers to synchronize their oestrus cycles so that they all come on heat at relatively same time. The cows/heifers that manifest oestrus are then artificially inseminated using frozen semen.
Justification	Heat detection requires significant labor, time, and expertise. Therefore, FTAI synchronizes ovulation, allowing for insemination at a predetermined time, which eliminates the need for continuous heat detection and reduces labor requirements. Timely insemination is crucial for successful conception. Variability in heat detection can result in suboptimal timing of insemination. FTAI ensures that insemination occurs at the optimal time for fertilization that lead to higher conception rates and improved reproductive efficiency. Irregular breeding schedules can lead to inconsistent calving intervals, complicating herd management and production planning. FTAI creates more uniform and predictable calving intervals, facilitating better planning and management of herd reproductive cycles and overall farm operations.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, public and private extension service, Sahiwal Breeders Associations and cooperatives
Approaches to be used in dissemination	• Exhibition, Agricultural shows, regular localized meetings, demonstration plots • Use of digital platforms

	• Print media promotional materials (posters, brochures, leaflets, pamphlets and manuals) • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services
Critical/essential factors for successful promotion	• Functional regional centres for sustainable supply of quality semen and bulls. • Proper maintenance of records of parents (sire and dam) to avoid inbreeding. • Performance recording and registration of the offspring in the farms. • Year-round availability of quality feeds.
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) – to train farmers on ART and monitor implementation • Private artificial insemination service providers for timely provision of quality semen • KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation • Kenya Livestock Breeders Association (KLBA) -maintain records of the up-grading scheme for crosses and issue registration certificates for the animals • Sahiwal breeders - Maintain records and monitoring of the Community based breeding scheme and marketing of breeding animals. • Kenya Animal Genetic Resources Centre (KAGRC) – collect semen of selected dairy bulls from KALRO and other centres, and distribute to regional Artificial Insemination (AI) centres
C: Current situation and future scaling up	
Counties where already promoted if any	Kajiado, West Pokot and Narok
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Weak livestock recording and registration • Feed availability • Limited skills in Fixed Time Artificial Insemination
Suggestions for addressing the challenges	• Support for livestock recording and registration • Training in FTAI • Documentation of FTAI and knowledge sharing • Training on feed conservation

Lessons learned in upscaling if any	• Need to dispel cultural myths like FTAI calves are weaker than those sired by bulls • Provide adequate information on FTAI technology
Social, environmental, policy and market conditions necessary for development and upscaling	• Create awareness and acceptance of FTAI to make it socially acceptable (milk is an important part of the local diet and any technology to increase milk production will be readily acceptable). • Promote production of fodder and feeds to prevent degradation of pasturelands. • Counties should put in place policies that support improved breed methods for livestock • Promotion of nutrient cycling • Good milk and breeding animals market and value addition to cater for increased production
Basic costs of the TIMP	• Hormones cost about KES 90 per cow
Estimated returns when using the TIMP	If this TIMP is implemented, it is expected that farmers will experience increased economic returns arising from superior germplasm. Milk production will improve from 2 liters per day per cow to 5-10 liters per day per cow. Cost of a bull up to Kes 150,000
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in dissemination, adoption and scaling up	• Women have limited access to FTAI technology, information and knowledge • Women have limited access to FTAI education, training and extension services • Women have less access to resources such as credit, implements and inputs to implement the technology • Men dominate decision on livestock production and marketing at the household level • Women and youth have less access to land for dairy production
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities exist for learned youths in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for dairy farming. • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the technology • VMGs have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.

VMGs related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities exist for learned youths in performing the task
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Keyian group ranch in Trans Mara, Kajiado Sahiwal breeders and West Pokot
Application guidelines for users	• Magothe, T. M., Mwangi, D. K., Wasike, C. B., Waineina, R. W., Miyumo, S. A., Mwangi, S. I., & Ilatsia, E. D. (2023). Response to hormonal treatment and conception rates of Sahiwal cows subjected to fixed time artificial insemination in pastoral dairy systems. Tropical Animal Health and Production, 55(1), 49. • Waineina, R.W., Mwangi, S.I., Wasike, C.B., Mwaura, T.M., Mukhebi, L., Mwangi, D., & Ilatsia, E.D.. (2022). Enhancing productivity and resilience of Sahiwal-based pastoral dairy systems through accelerated genetic gains and reproductive technologies. End of KCSAP adaptive Sahiwal project report
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO DRI Naivasha P.O. Box 25 -20117 Naivasha, Kenya Email: director.dri@kalro.org Tel: + 020 2390930
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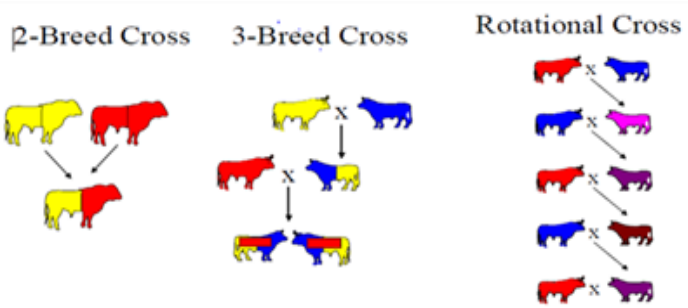
Partner organizations	Maseno University, Livestock Recording Centre, Kenya Livestock Breeders Association, Kenya Animal Genetic Resource Center,

Gaps

- Monitoring of FTAI progenies

2.1.2 Dairy cattle selection and cross breeding

2.1.2 TIMP name	**Dairy cattle selection and cross breeding**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Some of the problem to be addressed by practicing dairy cattle selection include: Inconsistent or low milk yields among cows can lead to reduced overall dairy production and profitability, Infertility or suboptimal reproductive performance can lead to longer calving intervals and reduced lifetime productivity, High incidence of diseases such as mastitis can reduce milk quality, increase veterinary costs, and affect cow longevity and limited genetic

	diversity can lead to inbreeding depression, which affects health, fertility, and productivity. In addition, some problems to be addressed by crossbreeding include; certain purebred breeds may not be well-adapted to specific environmental conditions, leading to poor performance and high input costs for maintaining purebred herds with specific needs can reduce overall economic efficiency.
What is it? (TIMP description)	This is a continuous process involving selecting the best cows and bulls to be future parents using selection criteria set in the breeding program. Cross breeding is mating parents of different breeds with the aim of increasing productivity, for example mating indigenous cattle using the Sahiwal/exotic germplasm. The following are different ways of crossbreeding depending on the breeding program. 
Justification	By addressing these problems through careful selection and crossbreeding, dairy farmers can improve the overall performance, health, and profitability of their herds, contributing to more sustainable and productive dairy operations. Crossbreeding process increases milk production from 10 litres compared to about 1 litre daily from indigenous cattle. The bull calves grow fast and reach maturity early for slaughter, supplementing the household's source of income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, Extension agents, Agro-pastoral and pastoral communities interested in dairy Production, Researchers, Extension service providers
Approaches to be used in dissemination	Training of Trainers (ToTs), Extension publications (leaflets, booklets, posters), Pastoral/farmer Field Schools, local FM radio stations, Farmer group training, Digital platforms
Critical/essential factors for successful promotion	• Functional regional centres for sustainable supply of quality semen • Proper maintenance of records of parents (sire and dam) to avoid inbreeding • Performance recording and registration of the offspring in the farms • Year-round availability of quality feeds
Partners/stakeholders for scaling up and their roles	• Extension Service Providers (Public and Private) - To train farmers and provide advice on the benefits of cross-breeding.

	• Private artificial insemination service providers – Timely provision of quality semen • KALRO – Technology development and fine tuning, ToT, backstopping and monitor implementation • Kenya Livestock Breeders Association (KLBA) - maintain records of the up-grading scheme for crosses and issue registration certificates for the animals • Kenya Animal Genetic Resources Centre (KAGRC) – collect semen of selected Sahiwal bulls from KALRO, store, and distribute to regional Artificial Insemination (AI) centres
C: Current situation and future scaling up	
Counties where already promoted if any	Kajiado, West Pokot and Narok
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu and West Pokot
Challenges in development and dissemination	• Inadequate technical skills among technical staff • Inadequate extension materials
Suggestions for addressing the challenges	• Training on crossbreeding to farmers and capacity build technical staff • Documentation of crossbreeding information for knowledge sharing
Lessons learned in upscaling if any	Need to dispel cultural myths that, AI calves are weaker than those sired by bulls
Social, environmental, policy and market conditions necessary for development and upscaling	• Awareness and acceptance of crossbreeding (milk is an important part of the local diet and any technology to increase milk production will be readily acceptable; the Sahiwal is a dual-purpose zebu that has better performance than the indigenous cattle) • Manure use to improve pastures • Good milk market and value addition for increased production and income
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AI cost (KES 1000) or improved breeding bull (KES 140,000/bull) and associated cost
Estimated returns	Weaning weight increased by 62 kg from 108 to 170 kg. Increase in milk production produced (about 3- 6lts/day) by the crossbreed under grazing with minimal supplementation Extra 3 - 6 litres/cow/day @ 40 per litre farm gate = KES 120 -240
Gender issues and concerns in development, dissemination, adoption and scaling up	• Low literacy for women and men in pastoral areas yet they are expected to keep milk records • Limited access to information and capital • AI is mainly carried out by men and the youth • Despite their role in livestock production, women's control traditionally declines when productivity increases

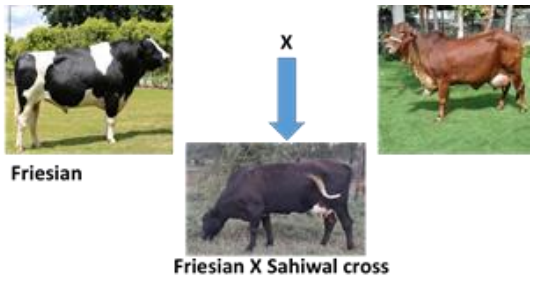
	• Women are disadvantaged when livestock and products are especially marketed in organized groups whose membership is predominantly men
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Milk has high local demand therefore offers an opportunity for women and youth who are mostly involved in marketing • Need to have gender friendly training materials with illustrations to enhance communication to all gender • Proper timing of agricultural related meetings will allow participation by all the gender categories • Have well organized gender friendly markets and marketing system
VMG issues and concerns in development and dissemination	• VMGs lack of access to input services including information • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by of dairy technologies by VMGs due lack of awareness • Need to train the youth in value addition and agri-business skills
VMG related opportunities	• Milk is important for health and there is need to target VMGs for dissemination • Target VMGs for cross breeding activities and ensure their animals are included in upscaling • Increased milk production hence improved nutrition and increased income • Increased opportunity for VMGs to engage in marketing of milk and its products • Opportunity for youth employment as service providers
E: Case studies/profiles of success stories	
Success stories from previous similar projects	An apparent change of the indigenous cattle to Sahiwal crosses (brown coat color) in Narok (Keyian Sahiwal Breeders) and Kajiado (Kajiado Sahiwal association) counties
Application guidelines for users	Refer to the crossbreeding protocol
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling and needs further research
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha

	Tel: + 020 2390930, Email: director.dri@kalro.org
Lead organization and scientists	KALRO - Evans Ilatsia, Ruth Waineina, Miriam Nakeel
Partner organizations	University of Nairobi, Directorate of Veterinary Services, KLBA, KAGRC

Gaps

1. Need for genetic and phenotypic characterization of the Small East African Zebu (SEAZ) population
2. Incorporate lactation length as one of the selection criteria for the SEAZ breeding cattle.
3. Establish hormonal profiles of SEAZ cows/heifers.

2.1.4 Friesian Sahiwal Crossbreed

2.1.3 TIMP name	**Friesian Sahiwal Crossbreed**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Some of the problems to be addressed by crossbreeding Friesian and Sahiwal include: purebred Friesians may not be well-adapted to specific environmental conditions where Sahiwals are kept, leading to poor performance and high input costs for maintaining Friesian with specific needs can reduce overall economic efficiency.
What is it? (TIMP description)	This is mating Sahiwal breed cow with Friesian bull or artificial inseminating Sahiwal cow using Friesian frozen semen.   Friesian Sahiwal cross
Justification	The Sahiwal × Friesian cross breed is a hardy cow that can survive in high and low altitude climatic conditions. The advantages of using of cross breeds to improve productivity

	include; increased herd productivity and resilience of the high yielding germplasm in the ASALs or in high potential areas due to climate change, increased productivity and of the progeny (crossbreds). Sahiwal produce 1,525 liters of milk per lactation per cow while a crossbred produce 4,575liters of milk per lactation
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Extension service providers, Researchers, Dairy farmers in high potential areas under low management practices and dairy farmers in ASALs
Approaches to be used in dissemination	Training of Trainers (ToTs), Provision of extension publications (leaflets, booklets, posters) Pastoral/Farmer Field Schools, Farmer group training, Agricultural Innovation Platforms (AIPs)
Critical/essential factors for successful promotion	• Functional regional centres for sustainable supply of quality semen • Proper maintenance of parent records (sire and dam) to avoid inbreeding • Performance recording and registration of the offspring in the farms • Year-round availability of quality feeds
Partners/stakeholders for scaling up and their roles	• Extension service providers link up the farmers with the source of breeding animals and monitor implementation • Private artificial insemination service providers – timely provision of quality semen • KALRO – Technology development and fine tuning, • ToT, backstopping and monitor implementation • Kenya Livestock Breeders Association (KLBA) - Maintain records of the up-grading scheme for crosses and issue registration certificates for the animals • Kenya Animal Genetic Resources Centre (KAGRC) – Collect semen of selected Sahiwal Friesian crossbred bulls from KALRO, store, and distribute to regional Artificial Insemination (AI) centres
C: Current situation and future scaling up	
Counties where already promoted if any	• Kajiado and Narok
Counties where TIMP will be upscaled	• Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in development and dissemination	• Limited knowledge on the existence of the Sahiwal Friesian cross breeds • Inadequate extension materials and publications • Inadequate technical skills among technical staff
Suggestions for addressing the challenges	• Documentation of the Sahiwal Friesian Crosses and knowledge sharing

	• Training on crossbreeding to farmers and capacity build technical staff
Lessons learned in upscaling if any	• Need to dispel cultural myths like crossbred calves are inferior than those sired by bulls • There need to embrace semi-intensive/intensive production system with crossbred cattle
Social, environmental, policy and market conditions necessary for development and upscaling	• Awareness and acceptance of crossbred cows (milk is an important part of the local diet and any technology to increase milk production will be readily acceptable; the Sahiwal is a zebu like the indigenous cattle) • Promotion of nutrient cycling • Good milk market and value addition to cater for increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	• AI cost (KES 1000) or improved breeding bull (KES 140,000/bull) and associated cost
Estimated returns	• Increase in milk production produced (about 9lts/day) by the crossbreed under grazing with minimal supplementation • Extra 9 litres/cow/day @ 40 per litre farm gate = KES 360
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women, who mainly own small livestock have less access and decision making power over large stock and their products • women's access control in livestock production decline with increased productivity • Women and youth lack access to the service and input delivery systems in livestock production, which are male dominate • Women have triple roles and have limited time for training • Women and youth have limited access to livestock markets technology
Gender related opportunities	• Have well organized gender friendly markets and marketing system • Making credit accessible to women • Increased milk production hence improved household nutrition, increased income, increased involvement of women and youth in milk marketing and dairy agribusiness
VMG issues and concerns in development and dissemination	• lack of access to input services including information by VMGs • Limited access to training and extension services by VMGs

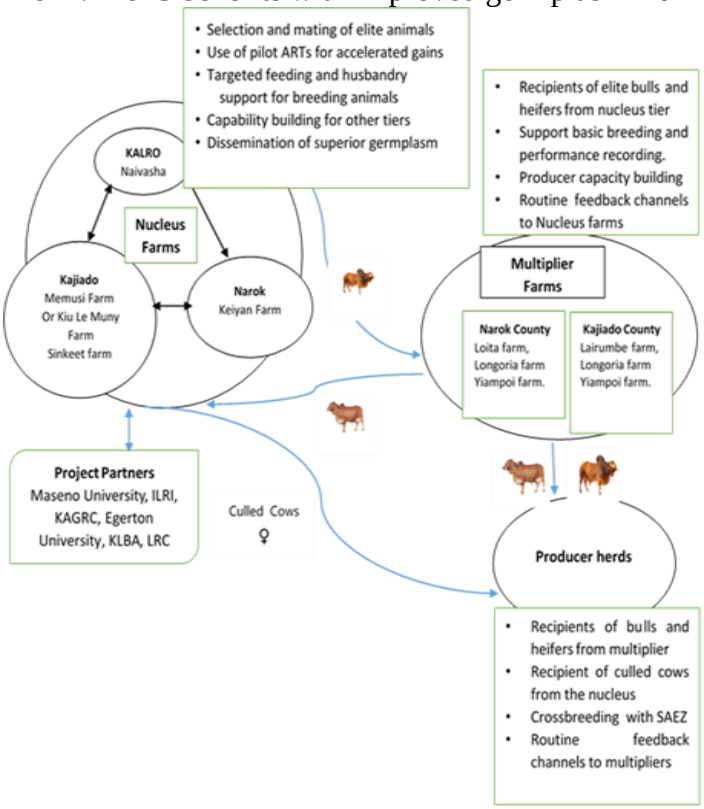
	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities
VMG related opportunities	• Milk is important for health and there is need to target VMGs for dissemination • Target VMGs for crossbreeds and upscaling activities to ensure they benefit through productivity and incomes. • Increased milk production hence improved household nutrition and increased income • Increased opportunity for VMGs to engage in milk marketing and dairy agribusiness
E: Case studies/profiles of success stories	
Success stories from previous similar projects	• Keyian group ranch in Trans Mara Narok County are using the Sahiwal bulls to crossbreed with the local breeds for improved milk production.
Application guidelines for users	• Muhuyi, W. Friesian-Sahiwah Crossbreds for More Milk (https://www.kalro.org/oldsite/fileadmin/publications/brochuresI/FresSahiMilk.pdf). • Refer to cross breeding guidelines
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Tel: + 020 2390930, Email: director.dri@kalro.org
Lead organization and scientists	KALRO - Evans Ilatsia, Ruth Waineina and Miriam Nakeel
Partner organizations	Directorate of Veterinary Services, KLBA, KAGRC

Gaps

1. Need to stabilize the Sahiwal Friesian cross breed
2. Need to validate the productivity of the crossbreeds in different agro-ecological zones

2.1.5 Community based breeding program (CBBP)

TIMP name	**Community based breeding program (CBBP)**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Community based breeding program addresses several key problems related to livestock production and rural livelihoods.

	These problems includes: genetic improvement, preservation of genetic diversity, community involvement in breeding program and sustainable agriculture.
What is it? (TIMP description)	The CBBPs is a three-tier breeding structure comprising of: Tier 1, Nucleus farms - KALRO DRI, Sahiwal ranchers and progressive individuals Tier 2, Multiplier farms – selected county farms in Kajiado, Narok and West Pokot- Tier 3, Producer herd– Ordinary pastoralists who are the main recipients of genetic materials. Superior germplasm is kept in Tier 1 and then disseminated to Tier 2. Tier 3 benefits with improved germplasm from Tier 2. 
Justification	Community based breeding program offers a holistic approach to addressing various problems in livestock production and rural development. By focusing on genetic improvement, community empowerment, sustainability and cultural preservation, CBPPs contribute to resilient and inclusive agricultural systems that benefit both present and future generations.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers, researchers, public and private extension service, Breeder Associations and cooperatives
Approaches to be used in dissemination	• Exhibition, Agricultural shows, regular localized meetings, demonstration plots • Use of digital platforms

	• Print media promotional materials (posters, brochures, leaflets, pamphlets and manuals) • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services
Critical/essential factors for successful promotion	• Functional regional centres for sustainable supply of quality semen and bulls • Functional Sahiwal breeders associations • Proper maintenance of records of parents (sire and dam) to avoid inbreeding • Performance recording and registration of the offspring in the farms • Year-round availability of quality feeds
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) – to train farmers on CBBP and monitor implementation • KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation • Kenya Livestock Breeders Association (KLBA) - maintain records of the up-grading scheme for crosses and issue registration certificates for the animals • Kenya Animal Genetic Resources Centre (KAGRC) – collect semen of selected dairy bulls from KALRO and other centres
C: Current situation and future scaling up	
Counties where already promoted if any	Kajiado and West Pokot
Counties where TIMP will be upscaled	
Challenges in dissemination	• Individual ownership of the bull not accepted • Weak livestock recording and registration • Feed availability • Inadequate extension publications • Lack of proper understanding of CBBPs process
Suggestions for addressing the challenges	• Training • Documentation of CBBPs and knowledge sharingTraining on feed conservation
Lessons learned in upscaling if any	• It is necessary to remove cultural illusions such as individual ownership of breeding bulls.
Social, environmental, policy and market conditions necessary for development and upscaling	• Small heards with lower GHGs emissions are more environmeatlly friendly • Social awareness and acceptance of CBBPs (milk is an important part of the local diet and any technology to increase milk production will be readily acceptable)

	• Good milk and breeding animal market and value addition to cater for increased production • Enactement of policies that support CBBP may hasten productivity
Basic costs of the TIMP	• The cost of this TIMP varies depending on the management practice
Estimated returns when using the TIMP	Through this TIMP, it is expected that farmers will experience increased economic returns arising from superior germplasm. Milk production will improve from 2 liters per day per cow to 5-10 liters per day per cow. Cost of a bull up to Kes 150,000.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to CBBP information and knowledge • Women have limited access to education, training and extension services • The livestock enterprise is mostly owned by men who dominated decisions at the household and community levels • Women have less access to resources such as credit and inputs for CBBP management practice infrastructural facilities • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities for youths exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to acquire the required infrastructure • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit • Employment opportunities for youths exist in performing the task
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Kajiado and West Pokot

Application guidelines for users	Waineina, R,W., Mwangi, S.I., Wasike, C.B., Mwaura, T.M., Mukhebi, L., Mwangi, D., and Ilatsia, E.D. (2022). Multiplication and delivery of improved Sahiwal cattle, selected exotics and their crosses for dairy production in low to medium potential areas. *End of KCSAP Sahiwal seed system project report.*
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO DRI Naivasha P.O. Box 25 -20117 Naivasha, Kenya Email: director.dri@kalro.org Tel: + 020 2390930
Lead organization and scientists	KALRO - Waineina, R,W., Mwangi, S.I., Mwaura, T.M., Wasike, C.B., Mukhebi, L., Mwangi, D., and Ilatsia, E.D.
Partner organizations	Maseno University, Livestock Recording Centre, Kenya Livestock Breeders Association, Kenya Animal Genetic Resource Centre.

Gaps
Establishing a community breeding farm

2.2 Feeds and Feeding

2.2.1 Improved Napier grass varieties (the varieties include, stunt and head smut tolerant Kakamega 1, 2, and 3; Ouma and South Africa)

2.2.1 TIMP name	**Improved Napier grass varieties (the varieties include, stunt and head smut tolerant Kakamega 1, 2, and 3; Ouma and South Africa)**
Category (i.e. technology, Innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low milk production due to limited availability of dairy feed as a result of prevalence of forage diseases
What is it? (TIMP description)	These are conventional and other Napier grass varieties (including Kakamega1/2/3, Ouma, and South Africa among others) mainly used for cut and carry for year-round feeding and silage. They are tolerant to stunting and head smut, are perennial and are also used as hedgerows in soil conservation. They produce 75% Dry Matter compared to Bana grass - the conventional fodder which is susceptible to stunt and smut. Napier has a crude protein (CP) content of 7-10%.

	 *Napier grass stand,* *Source: KALRO Naivasha*
Justification	Dairy cattle productivity is constrained by feed shortage. Napier grass var. Bana is the primary basal fodder in smallholder dairy systems; however, it is susceptible to head smut and stunt diseases which to lower its productivity and availability. Improved napier grass offer reliable year-round feeding and silage feed source, thereby improving dairy productivity. Stunt and head smut tolerant varieties assures supply of feed throughout the year in stunt/head smut prone areas.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, researchers,agripreneurs, extension officers, fodder traders
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Availability of adequate clean planting material • Attractive markets for dairy products
Partners/stakeholders for scaling up and their roles	• KALRO – Availing and multiplication of clean planting material, backstopping of Training Trainers (ToTs) and monitoring implementation • Frontline extension service providers (public and private) to train farmers • Farmer groups to provide demonstration plots and management of the plots
C: Current situation and future scaling up.	

Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot.
Counties where TIMP will be upscaled	All dairy counties including Uasin Gishu, Tharaka Nithi, Nyandarua, Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Nyamira, Makueni, Vihiga
Challenges in development and dissemination	Inadequate clean planting materials
Recommendations for addressing the challenges	• Use of biotechnology such as tissue culture for mass production • Decentralize propagation of planting materials from KALRO centres.
Lessons learned if any	• Need to involve farmer(s) groups in multiplication of clean planting materials as well as linkage to regulatory bodies.
Social, environmental, policy and market conditions necessary for development upscaling.	• Community awareness on the varieties' benefits and their willingness to adopt them • Adaptability of the varieties to prevailing local conditions • Availability of adequate disease-free planting materials. • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Good milk markets to cater for anticipated yield increases.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations.	
Basic costs	It will cost approximately KES73,000 per acre.
Estimated returns	The cost of production of Napier/acre/year is KES 73,000 producing 30 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day translating to a cost of KES 38/cow/day. A cow produces up to 7 litres of milk/day when fed Napier grass alone assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 350/day/cow giving gross margin returns of KES 312/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have less access to land for Napier grass cultivation • Women may have limited access to education, training and extension services

	• Women may have less access to resources such as credit, implements and inputs for Napier grass cultivation • While women and youth assist in the performance of Napier grass activities revenue from the technology is controlled by men, limiting women and youth access to the use of income.
Gender related opportunities	• Affirmative action opportunities exist for women and youth to acquire the required credit.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Napier grass cultivation. • VMGs may have limited access to agricultural information, technology and knowledge. • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers. • VMGs may have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, information and engage in productive dairy enterprise.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	This technology has been shared with other EAC countries like Uganda and Tanzania
Application guidelines for users	1. Wamalwa, J. *et al*. (2013) Napier Grass Smut Disease Management for High Milk Yield https://www.kalro.org/arlri/sites/default/files/smut_disease_threatyens_napier_grass_production.pdf) 2. Leaflets on stunt and smut tolerant varieties available in KALRO 3. Wandera *et a*l., (eds) 2016. East African Agricultural Productivity Project [EAAPP]: Technology Generation Report 2016. Kenya Agricultural and Livestock Research Organization [KALRO], Nairobi, Kenya
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director KALRO- Kitale P. O. Box 450-30200

	Kitale The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org
Lead organization and scientists	KALRO; F.N. Muyekho, Kabirizi J., K. Aemiro, R. Musangi, A. Nijimbere, M. Mutimura, S.Ajanga, I. Kariuki,S. Mwendia, Z.Khan, C. Midega
Partner organizations	KALRO, Masinde Muliro University of Science and Technology, International Centre for Insect Physiology and Ecology (ICIPE), National Livestock Resources Research Institute (NALIRRI), Uganda MoALD

GGap

Need to continue research on new Napier grass/other fodder varieties tolerant to stunt and smut diseases.

2.2.2 Oats for dairy production in frost prone areas

2.2.2 TIMP name	**Oats for dairy production in frost prone areas**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low milk productivity due to low quality feeds in frost prone areas
What is it? (TIMP description)	at is a tall cereal widely grown as fodder in tropical and subtropical countries. Oats is a versatile, succulent, fast growing, highly palatable and nutritious forage acceptable to all types of livestock.. Oats harvested at early dough stages make excellent hay for dairy cattle. Proper sun drying at this stage will make highly palatable and nutritious feed. Oat at dough stage has a CP of 10-12%.  *Oats for frost prone areas* *Source: KALRO Ol Joro Orok*
Justification	It is a cold tolerant plant that makes good hay and grains and is often grown mixed with vetch to improve crude protein content . There is need to sensitize farmers on use of oats hay

	in frost prone areas to mitigate feed scarcity which is the major constraint to milk production in these areas. Utilization of oats hay, increases milk yield in frost prone areas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small and medium scale dairy farmers, Extension service providers, agripreneuers, Researchers, forage producers, feed and producers.
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Acceptability of oat hay by farmers for livestock feeding • Trade-off between sale of oat grain and hay • Availability of oat seed • Availability of favorable milk markets
Partners/stakeholders for scaling up and their roles	• KALRO - multiplication of clean oats seed and training of ToTs. • ToTs backstopping and monitor implementation • Frontline Extension Service Providers (public and private) – to train farmers on use of oat hay • Oat seed growers – to provide certified seed to farmers. • KEPHIS – Seed quality regulation.
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua -KALRO - Ol joro Orok Centre, Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri
Counties where TIMP will be upscaled	All dairy counties including Uasin Gishu, Tharaka Nithi, , Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Nyamira, Makueni, Vihiga
Challenges in development and dissemination	Lack of awareness by farmers on conservation of good quality oats hay.

Suggestions for addressing the challenges	Training and awareness creation on utilization of oats hay as animal feed.
Lessons learned	• Innovations on manual hay balers important for timely harvesting and conservation. • Intercropping with vetch yields better quality forage
Social, environmental, policy and market conditions necessary	• Community awareness of the varieties' benefits and their willingness to adopt them • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community • Good milk markets to cater for anticipated yield increases
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Total cost is KES 41,000 per acre. Seed rate of 50 kg per acre
Estimated returns	The cost of production of oat grass/acre/year is KES 41,000 producing 3 Tons DM/acre/year. A 400 kg cow consumes 12 kgs DM/day which costs KES 17/kg DM translating to a cost of KES 342/cow/day. A cow produces up to 12 litres of milk/day when fed oat grass alone assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 600/day/cow giving gross margin returns of KES 258/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have less access to land for oat cultivation • Women may have limited access to education, training and extension services. • Women may have less access to resources such as credit, implements and inputs for oat cultivation • While women and youth assist in the performance of oat activities revenue from the oat hay sales and livestock is controlled by men, limiting women and youth access to the use of income
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for oat cultivation. • VMGs have less access to agricultural information, technology and knowledge. • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers. • VMGs may have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities.

	• There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit and control revenue from sale of hay and milk.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The technology has been demonstrated by Tulaga Dairy farmers and Keringet Community in Nyandarua and Nakuru Counies respectively
Application guidelines for users	Hay making pamphlets
F: Status of TIMP readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Tel: + 020 2390930, Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0719854357
Lead organization and scientists	KALRO; N.N. Kanegeni, E. Nyambati, G. Juma, . Muia J.M.K.
Partner organizations	KALRO, KEPHIS, MoALD, County governments

Gaps

1. Validation of Oat-legume mixture in different agro-ecological zones
2. Validation of Oat-based feeding regimes
3. Economic analysis of Oat-based fodder
4. Economics of milk production from Oat-based fodder feeding.

2.2.3 High altitude composite maize fodder

2.2.3 TIMP name	**High altitude composite maize fodder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem to be addressed	Low milk productivity due to low quantity of feeds in high altitude/cold areas.
What is it? (TIMP description)	High altitude composite (HAC) maize is an open pollinated variety (composite) with high forage production, suitable for silage production. It can produce up to 20 tons of dry matter when harvested at the dough stage of growth. The variety is recommended for silage in high altitude climatic conditions. The composite also has a high grain yield potential of 20 – 34 bags per acre and is suitable for the cold highlands where common hybrid maize does not do well. It is an early maturing variety (140-160 days). Other attributes include, tolerance to frost and foliar diseases and strong stalks.  *High altitude composite maize* *Source: KALRO Ol Joro Orok*
Justification	There is inadequate fodder for silage making and green chops in the humid highlands that are characterized by low temperatures and occasional frost. This has led to low milk productivity in these areas. High altitude composite maize is adaptable to these areas and is also a high dry matter producer, thereby making it a good feed option in the high altitude cold areas.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Dairy farmers in high altitude areas, Extension Agents, Researchers, agripreneurs, fodder producers and Service providers
Approaches used in dissemination	• Exhibition, Agricultural shows, regular localized meetings, demonstration plots • Print media promotional materials (posters, brochures, leaflets, pamphlets and manuals) • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services
Critical/essential factors for successful promotion	• Availability of seeds • Availability of training materials

Partners/stakeholders for scaling up and their roles	• KALRO- availing clean HAC maize seed and training. • MoALD and County Governments in sensitization and mobilization of dairy farmers. • Farmers –providing land for technology validation and utilization of HAC in dairy production. • KEPHIS- regulation of seed production and marketing
C: Current situation and future scaling up	
Counties where already promoted if any	Nakuru, , Laikipia, Baringo, Elgeyo Marakwet, Kericho, Nyandarua, Uasin Gishu,
Counties where TIMP will be upscaled	All high altitude counties including Meru, Bomet, Bungoma, Busia, Kericho, Kiambu, Nyeri, Kirinyaga, Kisii, Muranga, Nakuru, Nandi, Uasin Gishu, Nyandarua, Trans-Nzoia.
Challenges in dissemination	• Limited technical skills on silage making among extension staff • Inadequate extension materials and publications • High cost of polythene and other input materials for silage making
Recommendations for addressing the challenges	• Training of extension staff on silage making skills • Availing extension materials such as information leaflets and manuals on silage making.
Lessons learned	• The crop is multi-purpose used as food and feed for livestock • Grain or bran can be used for feed formulation
Social, environmental, policy and market conditions necessary	• Community awareness of the HAC variety benefits and their willingness to adopt • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Attractive milk markets and prices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The basic costs for producing 1 kg of silage is about KES 14.
Estimated returns	The cost of production of maize silage /acre/year is KES 150,000 producing 12 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day which costs KES15/kg translating to a cost of KES 195/cow/day. A cow produces up to 9 litres of milk/day when fed maize silage alone assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 450/day/cow giving gross margin returns of KES 255/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have less access to land for high altitude composite maize fodder cultivation

	• Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for maize cultivation • While women perform most activities on maize production men dominate decision on livestock revenue utilization at the household level.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit for seed and production of the fodder
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for maize cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers. • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, information and engage in productive dairy enterprise.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Dairy farmers and cooperatives (Tulaga and Nyala dairy farmers cooperative) in Nyandarua and Laikipia have successfully made silage from this HAC variety that has successfully positively impacted their dairy enterprises
Application guidelines for users	Farmer leaflet is available at Oljoro Orok Centre
F: Status of TIMP readiness (1. Ready for upscaling; 2.Requires validation; 3. Requires further research)	Ready for upscaling.
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302

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Lead organization and scientists	KALRO; N.N. Kanegeni N.N., , Nyambati E.M., , G. Juma G., Muia J.M.K.
Partner organizations	KALRO Ol Joro Orok, KALRO Kitale, MoALD, KEPHIS

Gaps

1. Validation of HAC maize fodder in different agro-ecological zones
2. Validation of HAC maize fodder-based feeding regimes
3. Economics of milk production from HAC maize fodder for green chop or silage feeding.

2.2.4 Fodder sorghum (Sorghum bicolor) variety E6518

2.2.4 TIMP name	**Fodder sorghum (*Sorghum bicolor*) variety E6518**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low milk productivity due to low quantity of feeds as a result of unreliable rains
What is it? (TIMP description)	E6518 sorghum is a drought tolerant high yielding, brown grain sorghum. It is dual purpose for grain and high-quality fodder. It is drought tolerant but is well suited to 750-2300 m.a.s.l. The variety takes 8 months to mature.
Justification	eed scarcity is common occurrence to dairy farmers both in the ASALs and high rainfall areas. This is a major challenge to milk production and incomes, among dairy producers. E6518 sorghum as a drought tolerant high yielding, brown grain sorghum for grain and high-quality fodder production. The crop is ideal for silage making and hence meeting the challenges of feed scarcity.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers, silage traders, extension agents, agripreneurs, service providers, feed producers
Approaches used in dissemination	• Training through Field days, demonstrations, posters, Famer field and business schools, shows • Literature including posters, brochures, pamphlets • Agricultural Innovation Platforms • Print and electronic media • Digital platforms,
Critical/essential factors for successful promotion	• Availability of seed • Training of farmers on management and utilization of sorghum

Partners/stakeholders for scaling up and their roles	• KALRO - Availing clean seed, training and research • MoALD and County Governments- Sensitization and mobilization of dairy farmers. • KEPHIS- quality seed regulation
C: Current situation and future scaling up	
Counties where already promoted if any	Nyeri, Kakamega, Bomet, Busia and Kericho Laikipia, Baringo, Elgeyo Marakwet, Machakos, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairying counties inclusing Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia.
Challenges in development and dissemination	• Limited technical skills on propagation and utilization of E6518 sorghum • Unavailability ofInadequate E6518 sorghum seed • Inadequate extension materials and publications on E6518 sorghum
Suggestions for addressing the challenges	• Training of extension officers and farmers • Improving seed access and information sharing • Involving forage private seed producers in bulking clean E6518 • Availing adequate extension materials and publications
Lessons learned	• Bulking can improve seed availability. • Management of ratoon crops to reduce cost of production
Social, environmental, policy and market conditions necessary	• Community awareness of the variety benefits and their willingness to adopt them • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Good milk prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per acre of sorghum is KES 52,000. The seed rate is 5 kg per acre @ KES 350 Seed cost per acre is KES 1,750.
Estimated returns	TP Sorghum yields 12 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day which costs KES 1.6/kg translating to a cost of KES 24/cow/day. A cow produces up to 8 litres of milk/day when fed sorghum green chop alone assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50, which translates to a revenue of Kes

	400/day/cow giving gross margin returns of KES376/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for sorghum cultivation • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for sorghum cultivation • While women perform most activities on sorghum production men dominate decision on livestock revenue utilization at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit as well knowledge in sorghum production.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for sorghum cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit and information for successful forage production
E: Case studies/profiles of success stories	
Success stories	Dairy farmers and cooperatives in Nyandarua and Nakuru have successfully made silage from this fodder sorghum Variety that has positively impacted their dairy enterprises
Application guidelines for users	1. Muyekho, F.N. (2017) Grow Fodder Sorghum For Increased Milk Yield (Brochure) 2. https://www.kalro.org/sites/default/files/Grow-fodder-sorghum-for-increased-milk-Dec2020.pdf
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research	Ready for upscaling
G: Contacts	
Contacts	The Institute Director,

	Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0719854357
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Partner organizations	KALRO Ol Joro Orok, KALRO Lanet, MoALD, KEPHIS.

Gaps

1. Validation of fodder sorghum in different agro-ecological zones
2. Validation of fodder sorghum-based feeding regimes
3. Economic analysis of sorghum-based silage feeding
4. Economics of milk production from sorghum-based silage.

2.2.5 Improved Brachiaria grass varieties

2.2.5 TIMP name	**Improved Brachiaria grass varieties**
Category (i.e. Technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low milk productivity due to scarcity/unavailability of productive and high-quality forages to bridge livestock feed deficit.
What is it? (TIMP description)	Brachiaria is a high yielding grass with good adaptability in different environments, particularly the warm medium altitude and coastal lowlands. It can be used as cut-and-carry, grazed or conserved as hay or silage and is a good alternative s to the common Napier grass which is susceptible to head smut and stunting diseases. Improved Brachiaria grass cultivars in Kenya include: *Brachiaria Brizantha cv.* Piata, *Brachiaria decumbence cv.* Basilisk, *Brachiaria Brizantha cv.* MG4, *Brachiaria Brizantha cv.* Xaraes *and Brachiaria Brizantha cv.* Marandu. Brachiaria has a CP of 12-16% and can produce 6-12 t/ha DM per year.

	  *Brachiaria grass* *Brachiaria grass seeds* *Source: KALRO Ol Joro Orok*
Justification	Brachiaria grasses are native to eastern Africa, have been widely adapted as livestock feed in South America and East Asia. It is palatable and nutritious with upto 16% Crude Protein. Besides their use as livestock feed, Brachiaria are known to contribute to carbon sequestration, ecological restoration and soil erosion control and hence play an important role in reducing greenhouse gasses and nutrient losses from soil.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Private and public extension service providers, smallholder dairy farmers, agripreneurs, researchers, fodder and feed producers.
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Acquisition and availing demonstration material such as planting materials • Development of information materials such as farmers' leaflets and booklets
Partners/stakeholders for scaling up and their roles	• KALRO-Avail clean planting material and training • Universities-Technical backstopping and research services • National and County Ministry of Agriculture, Livestock Development – organize farmer groups, mobilize farmers and facilitate farmer trainings

	• Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for the variety • Farmers: Test/validate and produce • CGIARS e.g. IITA: Funding and technical back stopping
C: Current situation and future scaling up	
Counties where already promoted if any	Lamu, Taita Taveta, Kilifi and Kwale, Machakos, Makueni, Kitui, Kakamega, Vihiga, Bungoma, Busia, Laikipia, Baringo, Elgeyo Marakwet, Kericho, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu and West Pokot.
Counties where TIMP will be upscaled	All dairy countes including Uasin Gishu, Tharaka Nithi, , Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Nyamira, Makueni, Vihiga
Challenges in dissemination	• High cost of brachiaria seed since it is imported • Inadequate extension services and awareness
Recommendations for addressing the challenges	• Use of brachiaria root splits as planting material • County Governments to partner with farmer groups and NGOs for extension and raising awareness
Lessons learned	• Farmer demand for the planting materials is high • Brachiaria does well in fertile soils • Brachiaria flowers well and forms spikelets, but the seeds are not viable but the use of root splits for propagation is very successful
Social, environmental, policy and market conditions necessary for development and upscaling	• Farmers willingness to adopt the technology • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community • Favourable weather conditions • Organized markets with favourable pricing policy to encouraging producers • Good markets for milk and brachiaria hay
D: **Economic, gender, vulnerable and marginalized groups (VMGs) considerations**	
Basic costs	Production of brachiaria is approximately KES 150,000 per acre.
Estimated returns	The cost of production of brachiaria /acre/year is KES 150,000 producing 12 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day which costs KES 13.6/kg translating to a cost of KES 213/cow/day. A cow produces up to 12 litres of milk/day when fed on brachiaria alone assuming that the required climatic conditions are favourable

	and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 600/day/cow giving gross margin returns of KES 388/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for brachiaria grass cultivation • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for Brachiaria grass cultivation • While women perform most activities on Brachiaria grass production men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit and information • Business opportunity exist for youth to rent land grow brachiaria grass and sell the splits to other farmers as well as hay
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for brachiaria grass cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit as well as information and knowledge.
E: Case studies/profiles of success stories	
Success stories	The technology has been successfully adopted by dairy farmers groups in Kieni, Nyeri County resulting in improved income generation.
Application guidelines for users	1. Muyekho, F.N. (2017) Grow Brachiaria in Drier Areas for Livestock Feed https://www.kalro.org/oldsite/sites/default/files/Grow-Brachiaria-in-Drier-Areas-Dec2020.pdf 2. Njarui, D.M.G (2016) Climate Smart Brachiaria Grasses for Improving Livestock Production in East Africa – Kenya Experience. Proceedings of the worKesop held in Naivasha, Kenya, 14 - 15 September, 2016.

	https://www.kalro.org/sites/default/files/Proceeding-Climate-Smart-Brachiaria-Grasses-Dec2016.pdf 3. Brachiaria Brochure.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for Upscaling.
G: Contacts	
Contacts	Institute Director Agricultural Mechanization Research Institute P.O. Box 340-90100 Machakos Telephone +254-020-7843033, +254-710 906 600 Email: director.amri@kalro.org The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	KALRO Katumani and KALRO Naivasha Donald Njarui D., , E. Nyambati E.M., , Kanegeni N.N., Ondabu N., and Ayako W.
Partner organizations	KALRO, KEPHIS, Becca ILRI, County Governments, MoALD

Gaps:

1. Need to identify niches for brachiaria seed production
2. Need for brachiaria National Performance Trial for seed certification and commercial release
3. Research on identification of new varieties, carrying capacity, persistence under cut and carry and grazing regimes
4. Validation on the brachiaria-based feeding regimes for dairy cattle
5. Economic analysis of brachiaria grass production
6. Economics of milk production from brachiaria based feeding regimes.

2.2.6 Common vetch (Vicia sativa) fodder

2.2.6 TIMP name	**Common vetch (*Vicia sativa)* fodder**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low milk productivity due to inadequate quality of feeds particularly low protein content of feeds in frost prone areas
What is it? (TIMP description)	Vetch is a climber legume that grows well in association with grasses to produce a mixed ley for grazing and silage making. It grows in 2190 - 2280 m.a.s.l. in lower highlands 5 (LH5) with average annual rainfall of 800-900 mm. Temperature range is 4.3-21.1^{o}C. Best soils are non-acidic sandy or sandy loam. Vetch can grow in all types of soils unless they are alkaline or waterlogged.  *Common vetch* *Source: KALRO Ol Joro Orok*
Justification	Low protein in dairy animal feed can cause significant reduction in milk productivity. Common vetch has high crude protein of 15-22% and highly acceptable as grazed or conserved forage which can to alleviate the low protein levels in feeds. It is persistent and a prolific seeder withstanding competition from grasses.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Private and public extension service providers, smallholder dairy farmers, agripreneurs, researchers, fodder and feed producers.
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals

	• Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Attractive milk market for small scale farmers • Availability of seed for farmers
Partners/stakeholders for scaling up and their roles	• KALRO-Avail the planting material, trainings and technical backstopping • County Governments and Ministry of Agriculture Livestock development- organize farmer groups and train farmers • Kenya Plant Health Inspectorate Services (KEPHIS) - Seed inspection and regulation. • CBOs, NGO's- Seed multiplication and technology dissemination • Farmers: Test/validate and produce seed
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy counties including Uasin Gishu, Tharaka Nithi, , Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Nyamira, Makueni, Vihiga
Challenges in dissemination	• Inadequate extension services and awareness • Vetch seed unavailability
Recommendations for addressing the challenges	• County Governments to partner with farmer groups and NGOs for extension and awareness • Work closely with farmer groups in seed bulking
Lessons learned	• Has fast and vigorous growth habit, smothers weeds and saves on labour for weeding • Flowers and seed early • Prolific in seed production • High biomass production
Social, environmental, policy and market conditions Necessary for development and upscaling	• Willingness of farmers to adopt the technology • Favourable weather conditions for growth of crop • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Favourable policies to support seed production and dissemination • Attractive milk market for small scale farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	Cost of production per acre is KES 67,000 (inclusive of cost of all activities)
Estimated returns	The cost of production of vetch/acre/year is KES 67,000 producing 3 Tons DM/year. A 400 kg cow consumes 3kgs DM/day as suppliment which costs kKES 22/kg translating to a cost of KES 87/cow/day. A cow increases production by 3 litres of milk/day when fed on vetch as suppliment assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 150/day/cow giving gross margin returns of KES 63/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for common vetch cultivation • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for common vetch cultivation • While women perform most activities on common vetch production men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit as well knowledge and information.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for common vetch cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information.
E: Case studies/profiles of success stories	
Success stories	• Ikinyukia Self Help group (composed of 20 members) in Nyandarua County sold vetch seeds and hay worth KES 3,062,000 (USD 34,022) over a one-and-a-half-year period. • High demand of vetch planting materials by farmers

Application guidelines for users	Lukuyu, B.A., Muriuki, L. and Lukuyu, M. (2008) Using vetch to feed livestock (Brochure), vetch production brochure.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Tel: + 020 2390930, Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	NKanegeni N.N., Nyambati E. M., Muia J.M.K., Juma G., and Ondabu N.
Partner organizations	KALRO, MoALD, KEPHIS

Gaps:

1. Need for National Performance Trials for common vetch *(Vicia sativa)* seed certification and commercial release
2. Further research required for intercropping with fodder grasses
3. Validate the inclusion and substitution levels
4. Economic analysis of common vetch forage and seed production
5. Economics of milk production from vetch based feeding regimes.

2.2.7 Desmodium (*Desmodium intortum*) - Napier grass intercrop

2.2.7 TIMP name	**Desmodium *(Desmodium intortum)*- Napier grass intercrop**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low milk production due to low quality of feeds
What is it? (TIMP description)	Desmodium is a protein rich creeping forage legume. It can be intercropped with Napier grass to improve the nutritive value of the Napier fodder, therefore increasing milk production. The mixture of Napier grass and desmodium increases biomass yield by about 30% and improves the nutritive value of the feed and feed utilization efficiency thereby increasing milk production.

	 ***Napier grass and desmodium intercrop*** *Source: KALRO Naivasha*
Justification	Feeding dairy cows on Napier grass alone is not enough to attain the production potential of dairy cows. This requires supplementation with a high protein feed supplement. The inclusion of desmodium is a cheaper supplementation option for dairy farmers. Feeding dairy cows on Napier grass-desmodium intercrop increases milk production as compared to feeding Napier grass alone.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Private and public extension service providers, smallholder dairy farmers, agriprenuers, researchers, fodder and feed producers.
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Availability of clean planting material (both Napier and desmodium)
Partners/stakeholders for scaling up and their roles	• KALRO-Avail the clean Napier planting material, technical backstopping • Seed stockists- Avail certified desmodium seeds • Universities-Technical backstopping and research services

	• National and County Ministry of Agriculture and Livestock development- organize and mobilize farmer groups • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Farmers: Test/validate and produce
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy counties including Uasin Gishu, Tharaka Nithi, , Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Nyamira, Makueni, Vihiga
Challenges in dissemination	• High cost of desmodium seed • Lack of awareness on Napier grass and desmodium intercrop • Inadequate extension services • Community attitude on high cost of desmodium seed and labour intensity especially at establishment
Recommendations for addressing the challenges	• Training and capacity building for farmers and availing extension materials • County governments to liaise with farmer groups and private extension agents for improved reach of extension services • Availing desmodium vines for establishment as a cheaper alternative to reduce cost
Lessons learned	• The intercrop improves yields and quality of grass fodder • The desmodium can be vegetatively propagated
Social, environmental, policy and market conditions necessary for development and upscaling	• Willingness of farmers to adopt the technology • Favourable weather conditions for crop growth • Desmodium can smoother the weeds growing in between Napier grass rows. • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Attractive milk market for small scale farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	TThe seed rate for desmodium is 3 kg/acre and the number of cuttings/acre required is KES 8,000.

Estimated returns	The cost of production of Napier-desmodium/acre/year is KES 49,000 producing 45 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day which cost KES 1 per kg translating to a cost of KES 16/cow/day. A cow produces up to 15 litres of milk/day when fed Napier grass-desmodium intercrop assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 750/day/cow giving gross margin returns of KES 734/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for Desmodium-Napier grass intercrop cultivation • Women have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for Desmodium-Napier grass intercrop cultivation • The intercrop reduces weeding labour which women mostly perform. Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit, knowledge and information.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Desmodium-Napier grass intercrop cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information.
E: Case studies/profiles of success stories	
Success stories	Githunguri Dairy farmers (Mihuko and Thakwa high breeders) in Kiambu County, Bahati farmers (Mwangaza, Ariithi and Ngecha) in Nakuru County
Application guidelines for users	Technical bulletins and farmer leaflets to be developed
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling

G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile: 0710854357.
Lead organization and scientists	Centre Directors, KALRO Naivasha, Ol Joro Orok, Muguga and Kitale. N. Kanegeni, W. Ayako, I. Kariuki and E. Nyambati.
Partner organizations	KALRO, Kephis, MoALD.

Gaps

1. Need for research on cutting frequency and persistence of Napier-desmodium intercrop
2. Economic analysis of desmodium forage and seed production
3. Economics of milk production from desmodium based feeding regimes.

2.2.8 Cassava-based Napier grass silage

2.2.8 TIMP name	Cassava-based Napier grass silage
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low milk production during the dry season due to feed scarcity.
What is it? (TIMP description)	Cassava-based Napier grass silage is a basal diet comprised of wilted chopped Napier grass: wilted cassava leaves: dry or fresh chopped cassava tubers in the ratio of 70:25:5. The mixture is fermented under anaerobic conditions for at least six weeks and can be ensiled in a pit or small airtight container/bag. It should however be fed after milking to avoid milk tainting.   *Cassava-based Napier grass silage making* *Source: KALRO Mtwapa*

Justification	Smallholder farmers in Kenya mainly depend on forages to feed livestock. Forage is plenty during the rainy season and scarce during the dry season and this has an effect on milk yields. Preservation of surplus forage has the potential for increasing or stabilizing milk production and the cassava-based silage is an option for providing high quality feed for the dry season. This silage can be used as a total ration without additional supplementation because its protein content is above 16%. This technology is based on use of unmarketable cassava roots and leaves which are not used for human consumption and would otherwise go to waste. The technology should be up-scaled in dairy production areas to sustain milk production during the dry season.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small and medium scale dairy farmers, agripreneurs. extension agents, researchers.
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	Favourable milk prices and reliable markets; suitable high yielding Napier grass and cassava varieties
Partners/stakeholders for scaling up and their roles	• KALRO- Training of Trainers' (ToT), backstopping and monitoring implementation • Extension service providers (public and private) – to train farmers on silage making • Farmer groups – provide land and manage demonstration sites
C: Current situation and future scaling up	
Counties where already promoted if any	Kilifi, Kwale, Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Uasin Gishu, Tharaka Nithi, Nyandarua, Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga,

	Kisumu, Nakuru, Nandi, Narok, Machakos, Nyamira, Makueni, Vihiga
Challenges in development dissemination	• Inadequate skills in silage preparation, • low awareness of the technologythe technology
Recommendations for addressing the challenges	• Capacity build the service providers who will train farmers on how to make cassava-based Napier grass silage
Lessons learned	• Cassava tubers (fresh or dry) can replace molasses in silage making • The farmers who used cassava-based Napier grass silage rarely experienced devastating effects of drought and they sustained milk production
Social, environmental, policy and market conditions necessary for development and upscaling	• Reliable markets and stable milk prices • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Premium milk prices during the dry season to cover for cost of silage making
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production for 1 kg silages ranges from KES 5 – 10 for silage made in a pit (5.5 tons; adequate for 2 cows for 3 dry months) or in a heavy-duty bag (30 kg for 1 cow per day); approx. weight of cow: 400 kg
Estimated returns	The cost of production of silage/acre/year is KES 55,000 producing 5.5 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day translating to a cost of KES 156/cow/day. A cow produces up to 12 litres of milk/day when fed silage alone assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 600/day/cow giving gross margin returns of KES 444/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for cassava and napier cultivation • The technology is labour intensive and may not be adopted by women who are already overburdened with other activities such as domestic, care and other productive activities • Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services • Women have less access to resources such as credit, implements and inputs for cassava based napier grass silage cultivation • Men dominate decision on livestock production and marketing at the household level

Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required inputs, credit and information • Employment opportunities for youths exist in making silage at a fee or for sale
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for cassava and napier grass cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required inputs, information and credit. • Employment opportunities for VMGs exist in making silage as an enterprise
E: Case studies/profiles of success stories	
Success stories	Kakuyuni, Malindi- Farmers improved milk production substantially after feeding cattle with cassava-based Napier grass silage.
Application guidelines for users	1. Leaflet on silage making (English and Kiswahili) and manual 2. Cassava based Napier grass silage technologies manual. Both available on KALRO website 3. Wandera *et al.,* (eds) 2016. East African Agricultural Productivity Project [EAAPP]: Technology Generation Report 2016. Kenya Agricultural and Livestock Research Organization [KALRO], Nairobi, Kenya
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Mtwapa
Lead organization and scientists	KALRO Rahab Muinga R.W., Lewa K.K., Mkuzi H., Saha H.M., Mambo L.C.
Partner organizations	Pwani University, CBOs, DLPOs (Kwale, Kilifi and Malindi), Heifer Project International (HPI). MoALD

Gaps

(i) Validate cassava-based feed formulations in selected dairy counties
(ii) Economic analysis of cassava-based feed formulation
(iii) Economics of milk production from cassava-based Napier grass silage

2.2.9 Tree Lucerne or Tagasaste- (*Chamaecytisus prolifera*)

2.2.9 TIMP name	**Tree Lucerne or Tagasaste- *(Chamaecytisus prolifera)***
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low milk productivity due to low quality feeds
What is it? (TIMP description)	Tree Lucerne is a perennial legume shrub rich in crude protein and grows in medium warm altitudes and cold highlands (1500 – 2500 m.a.s.l) with 600 -1600 mm of rain annually. It can grow in all types of soil except in waterlogged conditions. It can be established as an alley crop with other food crops or as a hedge to make a live fence.  *Tree Lucerne* *Source: KALRO Ol Joro Orok*
Justification	The soft regrowths or twigs can be cut and fed to livestock to bridge the protein gap in the dairy cattle diet. Tree Lucerne has a CP of 18-28% and therefore used both as a fodder. It can used as a hedge, thereby reducing pressure on land for crop cultivation.Provides leaf meals which can be fed directly or be used in feed compounding.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers, extension agents, researchers, agripreneurs
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models

	• Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Availability of tree Lucerne seeds and seedlings
Partners/stakeholders for scaling up and their roles	• KALRO- Avail the planting material and technical backstopping • National and County Ministry of Agriculture and Livestock development. • Kenya Plant Health Inspectorate Services (KEPHIS)- Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for variety • Farmers: Test/validate and produce
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu and West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi.
Challenges in development and dissemination	Low level of awareness and lack of seed
Recommendations for addressing the challenges	Working closely with farmer groups in seed bulking and nursery establishment for seedling production is important to address seed shortage
Lessons learned	• County Governments to partner with farmer groups and NGOs for extension and awareness creation • Bulking of tree Lucerne seed through farmer groups to increase access to seed
Social, environmental, policy and market conditions necessary for development and upscaling	• Willingness of farmers to adopt the technology • Favourable weather conditions • Tree lucerne reduces soil erosion and acts as a windbreak • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Attractive milk market for small scale farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Basic costs	The basic cost of producing leaf meal from 1 acre is KES 75,000
Estimated returns	TTree lucerne / produces 4 Tons DM/acre/year. A 400 kg cow consumes 3kgs DM/day as suppliment, which costs KES 19/kg translating to a cost of KES 73/cow/day. A cow increases production by 4 litres of milk/day when fed on tree Lucerne as suppliment assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50, which translates to a revenue of KES200/day/cow giving gross margin returns of KES 126/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for tree Lucerne cultivation • Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for tree Lucerne cultivation • Men are more involved in hedge trimming activities
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit, knowledge and information.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for tree Lucerne cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information.
E: Case studies/profiles of success stories	
Success stories	Ikinyukia Self Help group in Kinangop, Nyandarua County involved in seed bulking and sales, farmers in Nakuru and Laikipia counties producing for forage.
Application guidelines for users	Farmer pamphlets and leaflets available at KALRO Oljoro Orok Centre
F: Status of TIMP readiness 1. Ready for upscaling; 2. Requires validation;	Ready for up scaling

3. Requires further research	
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Tel: + 020 2390930, Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	KALRO Ol Joro Orok, N.N. Kanegeni, G. Juma and E.M. Nyambati
Partner organizations	KALRO, MoALD, KEPHIS.

Gap:

1. Need for NPT for tree Lucerne seed certification and commercial release
2. Validate harvesting management for leaves and twigs
3. Validate the inclusion and substitution levels in dairy rations
4. Economic analysis of fodder tree Lucerne and seed production
5. Economics of milk production from fodder tree Lucerne based feeding regimes.

2.2.10 Sweet Lupin (*Lupinus albus* and *Lupinus angustifolius*)

2.2.10 TIMP name	**Sweet Lupin (*Lupinus albus* and *Lupinus angustifolius*.)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Protein gap in dairy cattle feeds leads to low milk production. Concentrates such as dairy meals are expensive to farmers.
What is it? (TIMP description)	Lupins are legumes whose grains are rich in crude protein (CP) of 26-36% and is an ingredient in animal feed formulations. The stubble is plowed back to increase soil fertility. There are two common varieties in Kenya: the broad leaved and narrow leaved. Some of the common varieties include *Lupinus albas* cv ultra, *Lupinus albas* cv kieve mutant, *Lupinus angustifolius* cv 28137, 28324. It is excellent in crop rotation with grasses and cereal crops. It grows in all types of soil but is sensitive to low soil pH. The dry beans are harvested, ground and mixed with maize meal in the ratio of 1 part lupin: 3 parts maize meal to make a dairy cattle feed supplement. The supplement is fed to milking cows at the rate of 1 kg for every 2 kg of milk.

	 *Sweet Lupin at pod stage*
Justification	Growing lupins offer farmers a cheaper source of animal protein.Use of lupin/maize meal will reduce the cost of dairy feed supplementation, enhance formulation and increase milk production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers, extension agents, researchers, seed companies, agripreneurs
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Availability of lupin seed and grain for feed formulation. • Feed formulation skills.
Partners/stakeholders for scaling up and their roles	• KALRO- Avail the planting material and technical backstopping • Ministry of Agriculture and Livestock Development-extension and awareness creation • Kenya Plant Health Inspectorate Services (KEPHIS)-Seed inspection • CBOs, NGO's- Seed multiplication and technology dissemination • Processors: Create demand for variety • Public and private agricultural extension services
C: Current situation and future scaling up	

Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi..
Challenges in development and dissemination	• Low farmer awareness of lupin potential as a concentrate feed • Unavailability of seed • Lack of knowledge for feed formulation
Recommendations for addressing the challenges	• Training and seed bulking by farmer groups.
Lessons learned	• There is need to supply enough seed and sensitize farmers on the potential of lupin as a feed ingredient for the success of the technology.
Social, environmental, policy and market conditions necessary for development and upscaling	• Willingness of farmers to adopt the technology. • Favourable weather conditions • The crop fixes nitrogen and helps in management of soil erosion • Lupin crop can be used in crop rotation and farrowing • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Attractive milk market for small scale farmers.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	It will cost about KES 75,000 per acre - (12 Kgs of seed is required for establishment of 1 acre).
Estimated returns	TLupin yields 1 Ton DM/acre/year. A 400 kg cow consumes 3kgs DM/day as suppliment, which costs KES 59/kg translating to a cost of KES 230/cow/day. A cow increases production by 6 litres of milk/day when fed on lupin as suppliment assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 300/day/cow giving gross margin returns of KES 70/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for Sweet Lupin cultivation • Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for Sweet Lupin cultivation

	• While women perform most activities on Sweet Lupin production, men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit, knowledge and information.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Sweet Lupin cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information.
E: Case studies/profiles of success stories	
Success stories	Ikinyukia Self Help Group in Nyandarua County doing Lupin production for sale and use as a concentrate feed.
Application guidelines for users	Brochures on feed formulation Lupin
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	KALRO Ol Joro Orok , N.N. Kanegeni N.N., Nyambati E.M., T Onyango T.A., G. Juma G. and Muia J.M.K.
Partner organizations	KALRO, KEPHIS and MoALD

Gaps

1. Need for validation of new sweet lupin *(Lupinus albus and Lupinus angustifolius)* varieties for feed rations
2. Need for sweet lupin NPT for seed certification and commercial release
3. Economic analysis of Lupin grain and seed production
4. Economics of milk production from Lupin grain-based feeding regimes.

2.2.11 Fodder Sweet potato vines (*Ipomoea batatas*)

2.2.11 TIMP name	**Fodder Sweet potato vines *(Ipomoea batatas)*.**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Protein gap in dairy cattle feeds leading to low milk production
What is it? (TIMP description)	odder sweet potato vines (SPV) are succulent creepers with edible tubers which form the roots and the crop feed reserve. They are easily established and the vines are used to feed livestock.  ***Sweet Potato Vines***
Justification	Poor feed quality is a major challenge to increased milk production to most smallholder dairy farmers. The SPV are rich in crude protein (12.5-15%), highly digestible and hence a good supplement fodder for dairy cattle. SPV are perennial and persistent if the tubers are not uprooted. They are prolific and regrow quickly after harvesting the vines. The high CP improves the feeding value of grass when fed as a mixture, improving the milk production of dairy cows.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers, extension agents, researchers, service providers, agripreneurs, seed companies
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings

	• Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesPublic and private agricultural extension services
Critical/essential factors for successful promotion	• Bulking and availing fodder SPV planting vines • SPV requires adequate water for optimal production
Partners/stakeholders for scaling up and their roles	• KALRO –Availing planting materials, Training of Trainers (ToT), backstopping and monitor implementation • Extension service providers (public and private)-To train farmers on SPV production and management • Farmer groups – Provide land and manage demonstration sites.
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi..
Challenges in development and dissemination	• Low farmer awareness of fodder SPV potential as supplementary fodder to grasses • Inadequate extension services • Lack of SPV planting materials
Recommendations for addressing the challenges	• Training and availing planting SPV materials to the farming communities • County Governments to liaise with farmer groups and private extension providers for enhanced extension services
Lessons learned	• There is need to develop bulking sites for supply of planting material and to sensitize farmers on SPV as a supplemental fodder to grasses and silage
Social, environmental, policy and market conditions necessary for development and upscaling	• SPV is a cover fodder crop that does not require manual weeding after establishment • It is perennial and vines can be harvested for a long time so long as the tubers are not uprooted. SPV is good for soil conservation due to its rapid ground cover property. • Availability of information on seed quality check policies implemented by KEPHIS that provides

	assurance of cleanliness of planting materials distributed to farming community. • Good milk markets to cater for anticipated yield increases.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	About KES 90,000 for initial establishment per acre (16,000 vines @ KES 3).
Estimated returns	Forage yield is 4 Tons DM/acre/year. A 400 kg cow consumes 3kgs DM/day as suppliment which costs KES 22.5/kg translating to a cost of KES 88/cow/day. A cow increases production by 3.5 litres of milk/day when fed on SPV as a suppliment assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 175/day/cow giving gross margin returns of KES 87/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for SPV cultivation • Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for SPV cultivation • The soil cover properties of the SPV reduces weeding demand of the crop releasing labour especially for women.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit, knowledge and information.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for SPV cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information.
E: Case studies/profiles of success stories	
Success stories	• Many farmers have sourced SPV for planting from KALRO centres

	• Dairy farmers in Kinangop in Nyandarua County are using SPV as a feed supplement • Spv SPV has been used by KALRO KIBOKO for demonstration in Narok and Taita-taveta counties with an increased request for planting materials from these counties.
Application guidelines for users	Pasture and fodder farmer booklet available at KALRO Ol joro orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling.
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. Box 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357 Other centres; KALRO Lanet, Kakamega and Kitale
Lead organization and scientists	KALRO Ol Joro Orok: N.N. Kanegeni N.N., Munyasia J., Nyambati E.M., Muia J.M.K., Juma G., Ayako W.O., Mukisira E.
Partner organizations	KALRO and MoALD

Gaps:

1. Validate the inclusion and substitution levels of Sweet potato vines in dairy cattle and goat diets
2. Economic analysis of sweet potato vines forage production
3. Economics of milk production from sweet potato vines-based feeding regimes.

2.2.12 Napier grass, gliricidia forage and maize bran silage

2.2.12 TIMP name	**Napier grass, gliricidia forage and maize bran silage**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Feed scarcity and low milk yield during the dry season
What is it? (TIMP description)	his is a basal diet conserved towards the end of the wet season for use during the dry season when forage production is low. It is a mixture of wilted chopped Napier grass, wilted gliricidia forage and maize bran in the ratio of 70:25:5. The mixture is fermented under anaerobic conditions for at least six weeks, in a pit or small airtight container/bag. The silage can be used as

	a total ration without additional supplementation because its protein content is above 16%. It should be fed after milking to avoid milk tainting.  *Napier grass, gliricidia forage and maize bran silage making* *Source: KALRO Mtwapa*
Justification	Smallholder farmers in Kenya mainly depend on forages to feed livestock. The Napier grass and gliricidia-based silage is an option for providing high quality feed during the dry season and the technology utilizes maize bran to replace molasses which is not readily available. This technology should be up-scaled in dairy producing areas to sustain milk production during the dry season.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers, extension agents, researchers, service providers
Approaches used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services • Public and private agricultural extension services
Critical/essential factors for successful promotion	• Favourable milk prices and reliable markets; suitable high yielding Napier grass, forage legumes and priced maize germ
Partners/stakeholders for scaling up and their roles	• KALRO –ToT backstopping and monitor implementation • Extension service providers (public and private) – to train farmers on silage making • Farmer groups- provide land and manage demonstration sites
C: Current situation and future scaling up	

Counties where already promoted if any	Kilifi, Kwale, Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi..
Challenges in dissemination	Inadequate skills in silage preparation, low awareness of the technology
Recommendations for addressing the challenges	Capacity build the service providers who will train farmers on how to make Napier grass, gliricidia and maize bran silage
Lessons learned	• Gliricidia and maize bran can replace molasses in silage making • The farmers who used Napier grass, gliricidia and maize germ silage did not experienced devastating effects of drought and they sustained milk production • effects of drought and they sustained milk production
Social, environmental, policy and market conditions necessary for development and upscaling	• Improved feed utilization efficiency hence less emissions. • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of napier and gliricidia planting materials distributed to the farming community • Financial benefits from premium milk prices during the dry season enhances chances of upscaling of the technology • Reliable markets and stable milk prices.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production for 1 kg silages ranges from KES 5 – 10 for silage made in a pit (5.5 tons; adequate for 2 cows for 3 dry months) or in a heavy-duty bag (30 kgs for 1 cow per day); approx. weight of cow: 400kg.
Estimated returns	The cost of production of silage/acre/year is KES 55,000 producing 5.5 Tons DM/year. A 400 kg cow consumes 12 kgs DM/day translating to a cost of KES 156/cow/day. A cow produces up to 12 litres of milk/day when fed silage alone assuming that the required climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 600/day/cow giving gross margin returns of KES 444/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for production of Napier grass, gliricidia and maize . This can affect the technology adoption • Silage making technology is labour intensive and may less adopted by women who are already overburdened

	with other activities such as domestic, care and other productive activities • Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for napier grass, gliricidia forage and maize bran silage making. • Men dominate decision on technology adoption household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit, knowledge and information. • Employment opportunities for youths exist in making silage as an income generating venture
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for napier grass, gliricidia forage and maize cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers for production of the forages • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities, hence affecting adoption. • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information. • Employment opportunities for youths exist in performing
E: Case studies/profiles of success stories	
Success stories	It has been used successfully by farmers in Kwale and Kilifi Counties where the technology was validated
Application guidelines for users	An extension leaflet is available for reference at the KALRO website.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Mtwapa
Lead organization and scientists	KALRO

	Munga G., Mambo, L., Ramadhan, A., and Muinga, R.
Partner organizations	KALRO and MoALD

Gap

Validate use of alternative legume forages such Vetch, Calliandra, Tree Lucerne among others.

2.2.13 Oat/ vetch intercrop

2.2.13 TIMP name	**Oat/ vetch intercrop**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low protein content in grasses fed to cattle leading to low mik yields
What is it? (TIMP description)	efers to grass-legume mixture where Vetch which is a climber legume and can intercropped with oat grass to improve the nutritive value of the feed, improve forage yield per unit, and increase milk production.
Justification	eeding dairy cows on oat grasses alone is not enough to attain the production potential of dairy cows due to low nutritive value. This requires supplementation with a high protein feed supplement. Feeding dairy cows on oat grass-vetch intercrop as green chop increases milk production as compared to feeding with Napier grass alone. Oat- vetch hay can be fed to cows or sold for income generation.  *Oat-vetch intercrop* *Source: KALRO Ol Joro* *Orok*
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small holder farmers,agriprenuers, extension officers and researchers
Approaches to be used in dissemination	• Farmer Field and Business School (FFPS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days

	• Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services • Public and private agricultural extension services
Critical/essential factors for successful promotion	• Availability of clean planting material and technical information brochures.
Partners/stakeholders for scaling up and their roles	• KALRO-Avail the planting material, training and technical backstopping • National and County Ministry of Agriculture andLivestock development- Extension services provision • CBOs, NGO's- Seed multiplication and technology dissemination • Farmers: Test/validate the technology, use of the technology on their dairy animals • Kephis- seed production regulation
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua - KALRO Ol Joro orok.
Counties where TIMP will be upscaled.	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi...
Challenges in dissemination	Labour intense technology especially at establishment. Availabilitry of the vetch seed during establishment.
Suggestions for addressing the challenges.	Timely sourcing of planting materials especially seeds. More promotion of the technology
Lessons learned in upscaling if any	Increases yields and quality of fodder
Social, environmental, policy and market conditions necessary for development and upscaling	• WVetch can smoother the weeds growing in between Napier grass rows, hence reducing workload in weeding. • Availability of information on seed quality check policies implemented by KEPHIS that provides assurance of cleanliness of planting materials distributed to farming community. • Good milk markets to cater for anticipated yield increases.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs of the TIMP	Cost of production of oat –vetch intercrop is about KES 74,000

Estimated returns when using the TIMP	The yield expected is 4.4 Tons DM/acre/year. A 400 kg cow consumes 12 kgs DM/day which costs KES 17/kg translating to a cost of KES 262/cow/day. A cow produces up to 15 litres of milk/day when fed oat/vetch intercrop assuming that climatic conditions are favourable and management practices are optimal. Price of milk/litre is KES 50 which translates to a revenue of KES 750/day/cow giving gross margin returns of KES 487/cow/day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for oat-vetchintercrop cultivation • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs, such as seeds, for Oat-vetch cultivation • While men mostly dominate decision on technology adoption, women may perform most activities on oat-vetch intercrop.
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit, knowledge and information.
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for oats-vetch grass intercrop cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities and hence low adoption • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Affirmative action opportunities exist for VMGs to acquire the required credit, knowledge and information.
E: Case studies/profiles of success stories.	
Success stories from previous similar projects	ATo be documented
Application guidelines for users	Farmer information leaflets
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research).	RRequire for validation
G: Contacts	
Contacts	The Institute Director,

	Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists.	CKALRO Naivasha and Ol Joro Orok. N. Kanegeni, G. Juma, W. Ayako, N. Mathai and E. Nyambati.
Partner organizations	KALRO, MoALD, KEPHIS.

Gaps.

1. Validate the oat/ - vetch legume in other counties
2. Further research on vetch intercrop with other grasses.

2.3 Forage Production

2.3.1 Community based range grass seed bulking

2.3.1 TIMP Name	**Community based range grass seed bulking**
Category	Management Practice
A: Description of technology, innovation or Management practice	
Problem to be addressed	Low pasture production due limited availability of range grass seeds in the formal market system.
What is it? (TIMP description)  Women harvesting grass seed	This is a package of management for bulking range grass seed at farm level. It entails guidelines on harvesting, processing and storage of range grass seeds at farm level.   Grass seed harvesting (L) and drying
Justification	Community-based range grass seed management and bulking is essential to ensure successful restoration of degraded rangelands. It guarantees availability of good quantity and quality seed for reseeding. The areas are managed to ensure regeneration and this makes the rangelands more productive and resilient to continue supporting livestock. The seeds are also shared or sold among members thus, can be source of household income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	County governments, Common Interest Groups (CIGs), Individual farmers, agripreneurs, Researchers

Approaches to be used in dissemination	• TDemonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Regular extension visits to smallholder farmers • Business orientation of the farmers • Availability of initial seeds • Land to establish the seed bulking fields • Availability of seed germination testing services • Availability of viable markets for the seeds
Partners/stakeholders for scaling up and their roles	• County governments – mobilization and training of farmers • Common Interest Groups (CIGs) – produce and market the seeds, train farmers, • Individual farmers – produce and market seeds • KALRO – backstopping, technology development and refinement • KEPHIS – seed certification
C: Current situation and future scaling up	
Counties where already promoted	Makueni, Taita Taveta, Kajiado, Narok, Tana River
Counties where TIMP will be up scaled	All dairy production areas including Taita Taveta, Kajiado, Makueni, Narok, Machakos, Nakuru, Tharaka Nithi
Challenges in dissemination	• Inadequate extension support services to carry out the dissemination work • Poor group dynamics • Limited availability of starter seeds
Recommendations for addressing challenges	• County governments to provide more support to extension staff • Training CIGs on how to work together • Encourage farmers to harvest seed from within the farm
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	• Strong group dynamics is important for success of the group activities • Registration and formal release of grass varieties by KEPHIS is crucial to facilitate formal marketing of the seeds • Registering the producer groups as seed merchants with KEPHIS to facilitate marketing is necessary
D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations	
Basic costs	Pasture seeds KES 5,000 (5kg @ 1,000) per acre Ploughing and harrowing KES 5,000 per acre Planting KES 4,000 (8 Mandays @ 500) per acre Weeding KES 2,000 (4 Mandays @ 500) per acre Total=KES 16,000 per acre
Estimated returns	ES 50,000 (50kg of seed @ 1,000) per acre ; or KES 28,000 (2,000 kg sale of DM @ 14/= per kg) per acre
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women and youth have limited access to land for production of the grass seeds may less access to resources such as credit, implements and inputs While women perform most activities on production, they may not have impact in decision making on pasture establishment
Gender related opportunities	• Employment opportunity exist for women and youth in performing management practices such as harvesting of grass seeds
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have limited access to land for production • VMGs may have less access to information and knowledge on the management practice • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities, hence low adoption • There is low adoption by the VMGs
VMG related opportunities	Employment opportunity exist for VMGs in performing the various management practices such as grass seed harvesting
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Some members of Kavatini Pastoralists Livestock Improvement Group (KAPALIG) completely transformed their lives using proceeds from seed sales. The members have also succeeded in training other farmers and are invited to train other farmers outside Makueni County.
Application guidelines for users	1. Mnene, W. N, , Kirwa E. C., Kidake B. K., Ogillo B. P., Kubasu D. and Kimitei R. Community based range grass seed bulking and management manual on KALRO website https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf

	2. Ogillo B.P., Kirwa E.C., Kidake B.K., and Mnene W.N How to Harvest Range Grass Seeds on KALRO website https://www.kalro.org/asal-aprp/sites/default/files/Brochure_on_range_grass_seed_harvesting__FINAL.pdf
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Ready for up scaling.
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 - 90138 Makindu, Kenya directorarlri@kalro.org +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

RGaps

1. However, It requires registration of the grass seeds by KEPHIS for wider formal marketing: process has already been initiated
2. Cost/benefit analysis of community-based range grass seed bulking need to be undertaken to facilitate adoption of the TIMP.

2.3.2 Buffel grass (Cenchrus ciliaris) var. MGD-1

2.3.2 TIMP Name	**Buffel grass (*Cenchrus ciliaris*) var. MGD-1**
Category	Technology
A: Description of technology, innovation or Management practice	
Problem to be addressed	Decline in livestock productivity due to feed shortage and unavailability of commercial range grass varieties
What is it? (TIMP description)	A rhizomatous range grass variety that is drought tolerant, persistence to grazing pressure and matures in 3-4 months. It is an ecotype of *Cenchrus ciliaris* from Magadi, Kenya. The crude protein (CP) at 50% flowering stage is up to 12% and dry matter of 2.5 t/acre. Suitable for direct grazing, cut and carry or baling. The variety has aggressive growth against weeds. It is early maturing, has vigorous growth after harvest, free from pests and diseases. It is good for rangeland rehabilitation and soil erosion control. Has over 20 years of productive life with proper management.

	 *Buffel grass var. MGD-1*
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 feeding needs of grazing livestock leading to declining productivity of the livestock. This makes it necessary to explore ways of improving performance of the grasses. Some of the options are identifying and promoting superior ecotypes and breeding to develop completely new varieties.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Researchers for further work including breeding, extension personnel, agriprenuers, farmer groups, CIGs and individual farmers
Approaches to be used in dissemination	• Trainings - workshops/Seminars/Meetings • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Use of digital platforms • Print media promotional materials (posters, brochures, leaflets, pamphlets and manuals) • Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Registration and certification of the variety with KEPHIS
Partners/stakeholders for scaling up and their roles	• KEPHIS - certification of the varieties • County governments – promotion of the varieties, assist farmers access the seeds

	• Farmer groups – use the varieties to produce feed for their livestock or sale • KALRO – backstopping, technology development and refinement
C: Current situation and future scaling up	
Counties where already promoted if any	Not promoted still awaiting seed certification
Counties where TIMP will be up scaled	Taita Taveta, Kajiado, Makueni, Narok, Machakos, Nakuru, Tharaka Nithi
Challenges in dissemination	Still under validation
Suggestions for addressing challenges	Still under validation
Lessons learned in up scaling if any	Still under validation
Social, environmental, policy and market conditions necessary for development and up scaling	• Registration and certification of the variety with KEPHIS
D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations	
Basic costs	Pasture seeds KES 5,000 (5kg @ 1,000) per acre Ploughing and harrowing KES 5000 per acre Planting KES 4,000 (8 Mandays @ 500) per acre Weeding KES 2,000 (4 Mandays @ 500) per acre Total=KES 16,000 KES per acre Cost of feed (6.4x12x1.3) KES 100 per day per 400kg cow
Estimated returns	KES 20,800 per acre per season (100/= i.e. 200/= milk sales of 4 litres per cow per day @ 50 less feed cost 100 for 208 days). The expected DM is 3,000 kg per acre which can sustain the cow for 208 days) OR KES 19,000 per acre per season (35,000/= i.e. 2,500 kg sale of DM @ 14/= per kg less cost of KES 16,000)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for Buffel grass var. MGD-1 cultivation • Women have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for Buffel grass var. MGD-1 cultivation • While women perform most activities on Buffel grass var. MGD-1 production men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Business opportunity exist for youth to rent land grow Buffel grass and sell to other farmers

VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Buffel grass var. MGD-1 cultivation • VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities and hence low adoption • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Employment opportunity exist for women and youths in grass seed harvesting
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Still under validation
Application guidelines for users	1. KALRO: Range grasses factsheet *Cenchrus ciliaris* (African foxtail grass) https://kalro.org/sites/default/files/African-foxtail-grass.pdf 2. Mnene, W. N, E. C. Kirwa, B. K. Kidake, B. P. Ogillo, D. Kubasu and R. Kimitei: Community based range grass seed bulking and management manual https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf Authors: 3. Heuzé V., Tran G., Baumont R., Lebas F., 2016. Buffel grass (*Cenchrus ciliaris*). Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO. https://www.feedipedia.org/node/482
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Still under validation
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 -90138 Makindu, Kenya directorarlri@kalro.org +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu GeRRI Muguga Dr. Everlyne Kirwa
Partner organizations	KEPHIS, County governments, farmers and farmer groups

Research Gap

- Finalize seed certification and formal release by KEPHIS

2.3.3 Buffel grass (Cenchrus ciliaris) var. TVT-3

2.3.3 TIMP Name	**Buffel grass (*Cenchrus ciliaris*) var. TVT-3**
Category	Technology
A: Description of technology, innovation or Management practice	
Problem to be addressed	Feed shortage, due unavailability of commercial range grass varieties
What is it? (TIMP description)	A rhizomatous range grass variety that is drought, persistence to grazing pressure and matures in 3-4 months. It is an ecotype of *Cenchrus ciliaris* from Taveta, Kenya. The leaves have a characteristic bluish-green in colour. It is suitable for direct grazing, cut and carry or baling.  Buffel grass var. TVT-3.
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 feeding requirements of grazing livestock leading to declining livestock productivity. Crude protein (CP) at 50% flowering stage is up to 11% and dry matter of 3 T/acre of Buffel grass var. TVT-3. The pasture spreads easily through rhizomes and competitively grows against weeds. Good for soil erosion control. Over 20 years of productive life with proper management 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Researchers for further work including breeding, extension personnel, farmer groups, agriprenuers,CIGs and individual farmers ,
Approaches to be used in dissemination	• Training of CIGs, Farmers, ToTs, FFBS, On-farm demonstrations • Agricultural shows/exhibitions/field day • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services • Demonstrations - On-farm and on station • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Registration and certification of the variety with KEPHIS
Partners/stakeholders for scaling up and their roles	• KEPHIS - certification of the varieties • County governments – promotion of the variety, assist farmers access the seeds • Farmer groups – use the varieties to produce feed for their livestock or sale • KALRO – backstopping, technology development and refinement
C: Current situation and future scaling up	
Counties where already promoted if any	Not promoted still awaiting seed certification
Counties where TIMP will be up scaled	Taita Taveta, Kajiado, Makueni, Narok, Machakos, Nakuru, Tharaka Nithi
Challenges in dissemination	Still under validation
Suggestions for addressing challenges	Still under validation
Lessons learned in up scaling if any	Still under validation
Social, environmental, policy and market conditions necessary for development and up scaling	• Registration and certification of the variety with KEPHIS
D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations	
Basic costs	Pasture seeds KES 5,000 (5kg @ 1,000) per acre Ploughing and harrowing KES 5000 per acre Planting KES 4,000 (8 Mandays @ 500) per acre Weeding KES 2,000 (4 Mandays @ 500) per acre Total=KES 16,000 per acre Cost of feed (6.4x12x1.3) KES 100 per day per 400kg cow
Estimated returns	KES 25,040 per acre per season (100/= i.e. KES 200 milk sales of 4 litres per cow per day @ KES 50 less feed cost 100 for 250 days) The expected DM is 3,000 kg per acre which can sustain the cow for 250 days) OR KES 26,000 per acre per season (42,000/= i.e. 3,000kg hay @ 14/= per kg less cost of KES 16,000)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for Buffel grass var. TVT-3 cultivation • Women may have less access to resources such as credit, implements and inputs for Buffel grass var. TVT-3 cultivation

	• While women perform most activities on Buffel grass var. TVT-3 production men dominate decision on production and marketing at the household level
Gender related opportunities	• Business opportunity exist for youth to rent land grow Buffel grass and sell to other farmers.Women have opportunities in gainful employment in seed harvesting and processing
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Buffel grass var. TVT-3 cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services hence affecting adoption of the technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Employment opportunity exist for women and youths in grass seed harvesting
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Still under validation
Application guidelines for users	1. KALRO: Range grasses factsheet *Cenchrus ciliaris* (African foxtail grass) https://kalro.org/sites/default/files/African-foxtail-grass.pdf • 2. Mnene, W. N, E. C. Kirwa, B. K. Kidake, B. P. Ogillo, D. Kubasu and R. Kimitei: Community based range grass seed bulking and management manual https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf Authors: 3. Heuzé V., Tran G., Baumont R., Lebas F., 2016. Buffel grass (*Cenchrus ciliaris*). Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO. https://www.feedipedia.org/node/482
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Still under validation
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12- 90138 Makindu, Kenya directorarlri@kalro.org +254 722289697

Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu GeRRI Muguga Dr. Everlyne Kirwa
Partner organizations	KEPHIS, County governments, farmers and farmer groups

Research Gap

- Finalize seed certification process and formal release by KEPHIS

2.3.4 Bushrye grass (*Enteropogon macrostachyus*) var.

2.3.4 TIMP Name	**Bushrye grass (*Enteropogon macrostachyus*) var. ENMA-KBK**
Category	Technology
A: Description of technology, innovation or Management practice	
Problem to be addressed	Feed shortage, due unavailability of quality commercial range grass varieties
What is it? (TIMP description)	This is a tufted perennial range grass that is tolerant to drought and to grazing pressure and matures in 3-4 months. It is an ecotype of *Enteropogon macrostachyus* commonly found in Kiboko in Makueni County, Kenya. Suitable for direct grazing, cut and carry or baling.  Bushrye grass var. ENMA-KBK
Justification	TPerformance of indigenous range grasses in terms of biomass yield, nutritive value, drought tolerance, tolerance to grazing etc. has not been good enough to satisfy the feeding requirements of grazing livestock leading to declining productivity. It is palatable and preferred crude protein (CP) up to 14% at 50% flowering and dry mater of 1.5 T/acre. It easily establishes from seed. It is also shade tolerant (Can be intercropped with fruit and timber trees such as *Melia Volkensii*) making it ideal for silvo-pastoral system. Has over 10 years of productive life with proper management. 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Researchers for further work including breeding, Extension personnel, farmer groups, CIGs and individual farmers
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Registration and certification of the variety with KEPHIS
Partners/stakeholders for scaling up and their roles	• KEPHIS - certification of the varieties • County governments – promotion of the variety, assist farmers access the seeds • Farmer groups – use the varieties to produce feed for their livestock or sale • KALRO – backstopping, technology development and refinement
C: Current situation and future scaling up	
Counties where already promoted if any	Not promoted, awaiting seed certification
Counties where TIMP will be up scaled	Taita Taveta, Kajiado, Makueni, Narok, Machakos, Nakuru, Tharaka Nithi
Challenges in dissemination	Under validation
Suggestions for addressing challenges	Under validation
Lessons learned in up scaling if any	Not documented, under validation
Social, environmental, policy and market conditions necessary for development and up scaling	Registration and certification of the variety with KEPHIS
D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations	
Basic costs	Pasture seeds KES 5,000 (5kg @ 1,000) per acre Ploughing and harrowing KES 5,000 per acre Planting KES 4,000 (8 Mandays @ 500) per acre Weeding KES 2,000 (4 Mandays @ 500) per acre Total=KES 16,000 per acre

	Cost of feed (6.4x12x1.3) KES 100 per day per 400kg cow
Estimated returns	KES 16,600 per acre per season (100/= i.e. KES 200 milk sales of 4 litres per cow per day @ 50 less feed cost KES100 for 166 days) The expected DM is 2,000kg per acre which can sustain the cow for 166 days) Or KES 12,000 per acre per season (KES 28,000 i.e. 2,000kg hay @ 14/= per kg less cost of KES 16,000)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for Bushrye grass var. ENMA-KBK cultivation • Women have less access to resources such as credit, implements and inputs for Bushrye grass var. ENMA-KBK cultivation • While women perform most production activities on Bushrye grass var. ENMA-KBK, • ENMA-KBK, decision on adoption is by men.
Gender related opportunities	• Business opportunity exist for youth to rent land Bushrye grass var. ENMA-KBK and sell seeds and forage to other farmers
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Bushrye grass var. ENMA-KBK cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities hence low adoption • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Employment opportunity exist for VMGs in grass seed harvesting
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Still under validation
Application guidelines for users	1. KALRO: Range grasses factsheet *Enteropogon macrostachyus* (Bush Rye) https://www.kalro.org/arlri/sites/default/files/Bush-Rye.pdf 2. Mnene, W. N, E. C. Kirwa, B. K. Kidake, B. P. Ogillo, D. Kubasu and R. Kimitei: Community based range grass seed bulking and management manual https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf Authors:

	3. Ogillo B.P., Kirwa E.C., Kidake B.K., and Mnene W.N: How to Harvest Range Grass Seeds. https://www.kalro.org/asal-aprp/sites/default/files/Brochure_on_range_grass_seed_harvesting__FINAL.pdf
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Still under validation
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12- 90138 Makindu, Kenya directorarlri@kalro.org +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu GeRRI Muguga Dr. Everlyne Kirwa
Partner organizations	KEPHIS, County governments, farmers and farmer groups

Research Gaps

1. Finalize seed certification process and formal release by KEPHIS
2. Development of new varieties

2.3.5 Horsetail grass (*Chloris roxburghiana*) var. CHROX-KBK

2.3.5 TIMP Name	**Horsetail grass (*Chloris roxburghiana*) var. CHROX-KBK**
Category	Technology
A: Description of technology, innovation or Management practice	
Problem to be addressed	Feed shortage, due unavailability of quality commercial range grass varieties
What is it? (TIMP description)	This is a tufted perennial range grass that is drought tolerant, persistent to grazing pressure and matures in 3-4 months. It is an ecotype of *Chloris roxburghiana* commonly found in Kiboko area in Makueni County, Kenya. Suitable for direct grazing, cut and carry or baling.  **Figure** *Horsetail grass*

Justification	TPerformance of indigenous range 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. Horse tail grass has crude protein (CP) of 16% at 50% flowering stage. It is fairly shade tolerant (can be intercropped with fruit and timber trees such as Melia Volkensii). Over 10 years of productive life with proper management. 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: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	• Researchers for further work including breeding, • Extension personnel, agripreneurs • Farmer groups, CIGs and individual farmers ,
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Public and private agricultural extension services • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Registration and certification of the variety with KEPHIS
Partners/stakeholders for scaling up and their roles	• KEPHIS - certification of the variety • County governments – promotion of the variety, assist farmers access the seeds • Farmer groups – use the variety to produce feed for their livestock or sale • KALRO – backstopping, technology development and refinement
C: Current situation and future scaling up	
Counties where already promoted if any	Not promoted still awaiting seed certification
Counties where TIMP will be up scaled	Taita Taveta, Kajiado, Makueni, Narok, Machakos, Nakuru, Tharaka Nithi
Challenges in dissemination	Still under validation

Suggestions for addressing challenges	Still under validation
Lessons learned in up scaling if any	Still under validation
Social, environmental, policy and market conditions necessary for development and up scaling	• Registration and certification of the variety with KEPHIS
D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations	
Basic costs	Pasture seeds KES 5,000 (5kg @ 1,000) per acre Ploughing and harrowing KES 5,000 per acre Planting KES 4,000 (8 Mandays @ 500) per acre Weeding KES 2,000 (4 Mandays @ 500) per acre Total=KES 16,000 KES per acre Cost of feed (6.4x12x1.3) KES 100 per day per 400kg cow
Estimated returns	KES 16,600 per acre per season (100/= i.e. KES 200 milk sales of 4 litres per cow per day @ 50 less feed cost 100 for 166 days) The expected DM is 2,000kg per acre which can sustain the cow for 166 days) OR KES 12,000 per acre per season (28,000/= i.e. 2,000kg hay @ 14/= per kg less cost of KES 16,000)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land for Horsetail grass var. CHROX-KBK cultivation • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs for Horsetail grass var. CHROX-KBK cultivation
Gender related opportunities	• Business opportunity exist for youth to rent land to grow and sell grass seeds to other farmers
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to land for Horsetail grass var. CHROX-KBK cultivation • VMGs may have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs such as quality planting materials, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities, hence low adoption • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Employment opportunity exist for VMGs in grass seed harvesting
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Still under validation
Application guidelines for users	1. KALRO: Range grasses factsheet *Chloris roxburghiana* (Horsetail grass) https://www.kalro.org/arlri/sites/default/files/Horsetail-grass.pdf 2. Mnene, W. N, E. C. Kirwa, B. K. Kidake, B. P. Ogillo, D. Kubasu and R. Kimitei: Community based range grass seed bulking and management manual found https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf 3. Ogillo B.P., Kirwa E.C., Kidake B.K., and Mnene W.N: How to Harvest Range Grass Seeds. https://www.kalro.org/asal-aprp/sites/default/files/Brochure_on_range_grass_seed_harvesting__FINAL.pdf
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Still under validation
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12- 90138 Makindu, Kenya directorarlri@kalro.org +254 722289697
Lead organization and scientists	KALRO ARLRI Kiboko Bryan P. Ogillo, Bosco Kidake, Dennis Kubasu GeRRI Muguga Dr. Everlyne Kirwa
Partner organizations	KEPHIS, County governments, farmers and farmer groups

Research Gaps

1. Finalize seed certification process and formal release by KEPHIS
2. Development of new varieties

2.3.6 Maasai Love Grass (*Eragrostis superba*) var. ERSU-1

2.3.6 TIMP Name	**Maasai Love Grass (*Eragrostis superba*) var. ERSU-1**
Category	Technology
A: Description of technology, innovation or Management practice	
Problem to be addressed	Feed shortage, low livestock productivity and rangeland degradation
What is it? (TIMP description)	perennial range grass species, densely tufted and is a good seeder ecotype selected from indigenous *Eragrostis*

 Lovegrass var. ERSU-1	*superba*. The grass is drought tolerant, persistent to grazing pressure and matures in 3-4 months.  Lovegrass var. ERSU-1
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. Dry matter production of Maasai Lovegrass var. ERSU-1 is 2.2 T/acre and crude protein (CP) of 9-11% at 50% flowering stage. The grass has a productive lifespan of over 15 years with proper management.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Researchers for further work including breeding, Extension personnel, agripreneurs, farmers, farmer groups and county governments
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Registration and certification of the variety with KEPHIS
Partners/stakeholders for scaling up and their roles	• KEPHIS - certification of the variety • County governments – promotion of the variety, assist farmers access the seeds • Farmer groups – use the variety to produce feed for their livestock or sale • KALRO – backstopping, technology development and refinement
C: Current situation and future scaling up	
Counties where already promoted if any	Not promoted, awaiting seed certification
Counties where TIMP will be up scaled	All dairy production countoes including Machakos, Taita Taveta, West Pokot, Baringo, Laikipia, Lamu, Kajiado, Mandera, Wajir, Garissa, Isiolo, Marsabit, Tana River
Challenges in dissemination	Under validation
Suggestions for addressing challenges	Under validation
Lessons learned in up scaling if any	Under validation
Social, environmental, policy and market conditions necessary for development and up scaling	Registration and certification of the variety with KEPHIS
D: Economic, gender, vulnerable, and marginalized groups (VMGs) considerations	
Basic costs	Pasture seeds KES 5,000 (5kg @ 1,000) per acre Ploughing and harrowing KES 5,000 per acre Planting KES 4,000 (8 Mandays @ 500) per acre Weeding KES 2,000 (4 Mandays @ 500) per acre Total KES 16,000 KES per acre Cost of feed (6.4x12x1.3) KES 100 per day per 400kg cow
Estimated returns	KES 20,800 per acre per season (100/= i.e. KES 200 milk sales of 4 litres per cow per day @ 50 less feed cost KES 100 for 208 days) The expected DM is 3,000 kg per acre which can sustain the cow for 208 days) OR KES 19,000 per acre per season (35,000/= i.e. 2,500 kg sale of DM @ 14/= per kg less cost of KES16,000)
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have less access to land to implement the technology • Women may have limited access to education, training and extension services • Women may have less access to resources such as credit, implements and inputs
Gender related opportunities	• Business opportunity exist for youth to lease land to grow and sell grass seeds to other farmers
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to implement the technology • VMGs may have less access to agricultural information, technology and knowledge

	• VMGs may also have limited access to finances to buy the required inputs such as quality seeds, manure and fertilizers • VMGs have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities hence low adoption • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	Employment opportunity exist for VMGs in grass seed harvesting
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Still under validation
Application guidelines for users	1. KALRO: Range grasses factsheet *Eragrostis superba* (Maasai love grass) https://www.kalro.org/arlri/sites/default/files/Maasai-love-grass.pdf 2. Mnene, W. N, Kirwa E.C., Kidake B. K., Ogillo B. P., Kubasu D.and Kimitei R.: Community based range grass seed bulking and management manual found https://www.kalro.org/asal-aprp/sites/default/files/Good_quality_range_grass_seed_manual_final-1.pdf 3. Ogillo B.P., Kirwa E.C., Kidake B.K., and Mnene W.N: How to Harvest Range Grass Seeds. https://www.kalro.org/asal-aprp/sites/default/files/Brochure_on_range_grass_seed_harvesting__FINAL.pdf
F: Status of the TIMP readiness (1. Ready for up scaling 2. Requires validation 3. Requires further research)	Still under validation
G: Contacts	
Contacts	Institute Director ARLRI Kiboko P.O. Box 12 90138 Makindu, Kenya directorarlri@kalro.org +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) to facilitate adoption of the ERSU ecotypes
3. There is need to conduct feeding trials for all the range grass varieties being promoted 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 consider in adoption of 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; C*enchrus 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.

2.3.7 Zero grazing unit

2.3.7 TIMP name	**Zero grazing unit**
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Poor housing of dairy cattle leading disease incidence • Inadequate knowledge on construction of zero grazing unit • Low awareness by farmers and service providers on benefits of housing dairy cattle
What is it? (TIMP description)	In zero-grazing system, cattle are confined in one place where feed and water are provided to the animals. It is a good system for keeping dairy cattle in densely populated, high rainfall areas, where land per farm family is small.

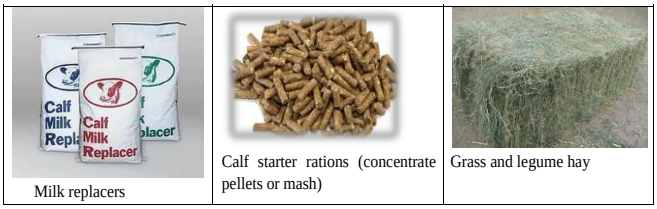
	Design of a simple zero grazing unit **Number of cows** / **Number of Cubicles** 1 / 2 2 / 3 3 / 5 4 / 6 5 / 7 6 / 9
Justification	PPoor housing predisposes cows to various body injuries, unfavorable weather and contribute immensely to poor animal welfare.Training of dairy farmers on animal welfare would therefore be a prerequisite to improvement of dairy cattle welfare. Further, energy lost in walking for pasture is saved for lactation, hence higher milk yields. Poor housing
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Farmers and extension officers, agripreneurs, input suppliers and Researchers
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services • Public and private agricultural extension services
Critical/essential factors for successful promotion	• Financial resources to support construction of the zero-grazing unit • Availability of land to support production of forages for the animals • Availability of locally available raw materials for constructing zero grazing unit • Availability of technical personnel to design and construct the zero-grazing unit • Human – animal relationshipSkills in handling animals in confinement
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) – to train farmers on zero grazing technology and monitor implementation • KALRO – technology development and fine tuning, ToT backstopping and monitor implementation

C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nyeri
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Local materials availability for construction of zero grazing unit • Limited skills in designing and construction • Poor hygienic conditions at the zero grazing unit • Inadequate extension materials • Reduced land sizes
Suggestions for addressing the challenges	• Training in construction of the zero grazing units • Documentation of zero grazing units and knowledge sharing
Lessons learned in upscaling if any	• Production in zero grazing units is higher • Farmers with zero grazing units must have adequate feed as animals fully depend on stall feeding
Social, environmental, policy and market conditions necessary for development and upscaling	• Social acceptance of the technology • Promotion of nutrient cycling by using the bio slurry from the unit • Good milk market and value addition to cater for increased production • Adoption of animal welfare regulations • Farmers
Basic costs of the TIMP	Cost of constructing 5 cubicle zero grazing unit is KES 79,750
Estimated returns when using the TIMP	Before the technology, it is assumed that the farmer practiced free range grazing which yielded an average of 6 – 8 litres/cow/day but with adoption of the technology the yield is expected to increase by 6 – 12 litres/cow/day under improved management. The gross monetary gain from this will be 12 * 50 * 3 = KES 1,800. The profit from the innovation will be KES 900 litres from 3 cows.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in dissemination, adoption and scaling up	• Women have less access to skills and knowledge on zero-unit construction • Women and youths may have less access to resources such as credit, materials and implements for zero grazing unit construction • Women and youth have less access to land for putting up a zero grazing unit • Men dominate decision making in construction at household level

Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit to put up zero grazing units • Employment opportunities exist for men in construction of the housing units
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have limited access to resources such as credit and land required for the implementation of the innovation • VMGs may have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities and hence low adoption • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	• Employment opportunity exist for VMGs in providing labour during construction • Affirmative action opportunities exist for VMGs to acquire the required credit
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Refer to construction of zero grazing unit leaflet at KALRO Naivasha
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO DRI Naivasha P.O. Box 25 -20117 Naivasha, Kenya
Lead organization and scientists	KALRO Paul Leparmarai, Tobias Onyango, William Ayako, John Nguru, Mathai Ndungu, David Mbugua, Ruth Waineina and Miriam Nakeel
Partner organizations	University of Nairobi, Directorate of Veterinary Services, MoALD, KLBA, KAGRC, DGBA

2.3.8 Dairy calf feeding regime

2.3.8 TIMP name	Dairy calf feeding regime
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem to be addressed	Poor growth performance of calves due to nder feeding and Llow awareness on proper feeding regime among farmers and service providers.
What is it? (TIMP description)	airy calf feeding regime is a practice involving improved nutrition for the dam (mother) especially in the last trimester of pregnancy, feeding calves on colostrum while housed to protect against from adverse elements of weather, parasites and diseases and using a defined schedule comprising milk, pellets and roughage until weaning. The calf would have doubled the weight at weaning.  Milk replacers | Calf starter rations (concentrate pellets or mash) | Grass and legume hay *Sample feeds used in calf rearing*
Justification	n Kenya, inadequate nutrition in smallholder dairy calves has been attributed to insufficient knowledge among farmers on best feeding practices. Dairy farmers lack knowledge of good calf feeding practices that provide appropriate and adequate nutrition to the dairy calves. Poor feeding practices in dairy calves have been proven to contribute to delay in initiation of rumen development. There is therefore need to strengthen capacity of farmers and other stakeholders to improve dairy calf feeding practices.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, County extension officers, agripreneurs, input suppliers and researchers
Approaches to be used in dissemination	Mass media and Web material's, Mobile Apps and SMS, Digital platforms • Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services • Public and private agricultural extension services

Critical/essential factors for successful promotion	• Hygiene environment when feeding calves • Ensure feeding equipment are clean • Provide the fresh whole milk regularlyAdherence to feeding regime • Year-round availability of quality milk/feeds
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) – to train farmers on calf feeding schedule • KALRO to provide current information to guide feeding of calves • KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nyeri, Garissa, Nakuru, Bomet, Siaya
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Feed/milk availability • Limited skills in calf management • Inadequate extension publications
Suggestions for addressing the challenges	• Training in calf feeding guidelines • Documentation of calf feeding guideline and knowledge sharing
Lessons learned in upscaling if any	• Based on the information from the on-station demonstrations, it is recommended that this technology be shared with interested farmers
Social, environmental, policy and market conditions necessary for development and upscaling	• Upscaling of the management practice is socially acceptable since it encourages farmers to raise healthy calves that will grow faster to increase the herd size • Farmer's willingness to adopt the technology as long as existing policy guideline allow access to quality extension services • The technology will also offer market opportunities for dairy calves that can reach the market weight early
Basic costs of the TIMP	The amount of milk required to rear the calf from birth to weaning is estimated as 4 litres/calf/day with an average of 650 grams of calf pellets/calf/day
Estimated returns when using the TIMP	A dairy farmer following the above regime will be able to wean the calf within 3 months having attained twice the birth weight. In addition such calves will have a shorter rearing period having grown at the right daily weight gain.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in dissemination, adoption and scaling up	• Women who mostly perform the task of calf feeding have limited access to information and knowledge • Women and youth have less access to productive resources such as credit and capital for improved calf feeding nd rearing • Men dominate livestock decisions at the household level including when and where to construct calf rearing units
Gender related opportunities	• Hustler fund and similar opportunities exist for women and youths to acquire required credit • Employment opportunities exist for women and youth males in calf rearing
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities, hence low adoption. • There is low adoption by the VMGs due to lack of awareness.
VMG related opportunities	• Employment opportunity exist for VMG males in calf rearing • Affirmative action opportunities exist for VMGs to acquire the required credit
E: Case studies/profiles of success stories	
Success stories from previous similar projects	NNot documented
Application guidelines for users	Refer to the calf feeding guideline
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO DRI Naivasha P.O. Box 25 -20117 Naivasha, Kenya
Lead organization and scientists	Paul Leparmarai, Robert Ouko, John Nguru, Mathai Ndungu, David Mbugua, William Ayako and Miriam Nakeel KALRO
Partner organizations	County Governments, MoALD, Self Help Africa, SNV

2.4 Feed Formulation

2.4.1 Feed rations formulation

2.4.1 TIMP name	Feed rations formulation

Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	High cost of feeding dairy animals contributing to reduced profitability in milk production
What is it? (TIMP description)	It is a technology to optimize the nutritional intake of dairy cattle while efficiently utilizing locally available feed resources, enhancing milk production and maximizing income. It aims at providing specific feed requirements (rations) based on the individual needs of dairy cows.  *Friesian cows feeding on silage-based ration*
Justification	T Use of commercial concentrates and forage supplements is not a common practice among smallholder dairy farmers. Adoption of dairy ration formulations that leverage locally available feed resources can be a significant boon for farmers. By formulating rations based on available feedstuffs, farmers can mitigate the cost of production. This approach not only helps in utilizing existing resources more efficiently but also contributes to cost savings, making dairy farming more economically viable, especially during seasons when feed resources are limited.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small and medium scale dairy farmers, extension agents, agripreneurs, service providers, researchers
Approaches used in dissemination	• Farmer field and business Schools (FFBS) and Farmer group training. • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals

	• Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Favourable milk prices and reliable markets • Availability of common feedstuffs in farms that can be utilized for cost-effective ration formulation
Partners/stakeholders for scaling up and their roles	• The county government and MoALD extension staff – Training of farmer groups and collecting feedback information required by researchers on the uptake and impact of the technology • Researchers – Further research, knowledge sharing and dissemination; provide laboratory services, train trainers and provide technical backstopping on feed formulation technologies • The National Government – Policy, legal and regulatory guidelines • The private organization (NGOs, CBOs, FBOs) extension staff – Train farmer groups and provide the required inputs to farmers and information on the technology to researchers. • KEBs and AKEFEMA – Standardization and quality regulatory guidelines • The local Universities – Provide students to participate in the training of trainers, provide laboratory services and further research to refine and adapt the technologies based on feedback from the field • Dairy co-operatives and other farmer groups – Provide inputs including land for production of forages, demonstration, and research purposes • Dairy farmers – Adoption and use of the technology to improve milk production at farm level. • The local MSMEs – Mass production, packaging and supply of cost-effective feed rations for the use by the dairy farming community
C: Current situation and future scaling up	
Counties where already promoted if any	Nyamira, Kiambu, Machakos, Bungoma, Siaya, Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu and West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi

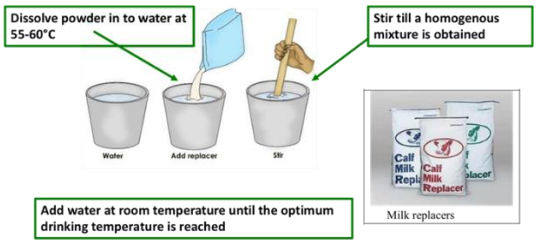
Challenges in development and dissemination	• Low awareness of the technology • Failure by the farmers to attend training sessions • Low ICT competence by dairy farmers
Recommendations for addressing the challenges	• Capacity building the service providers who will train farmers to formulate rations for dairy cows • Interested stakeholders can access the technology from ICT platform
Lessons learned	
Social, environmental, policy and market conditions necessary for development and upscaling	• Socially acceptable considering potential for reducing costs of production • It makes use of readily available resources and thus is economically suitable and environmentally friendly • milk products is likely to absorb addition produce resulting from adoption of the technology Need for policy environment that enc
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	The basic cost of the ration is KES 150 for a cow producing 10 liters of milk per day. Ration composition on as fed basis includes 31.4 kg of Napier grass, 10.3 kg of desmodium, 2.9 kg of maize germ, and 400 gm of stock lime.
Estimated returns	Calculated from the price of milk sold at KES 40 and considering the cost of the ration, a cow should produce 10 liters daily. There will be an extra 3 liters/cow/day, which translates to KES 120.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women often have limited access to feed formulation ration information and knowledge. Which can hinder women's participation and decision-making in use of the technology.. • Women may have limited access to education, training and extension services. • Women and youth have less access to resources such as credit, implements and inputs required for feed rations formulation • Men dominate decision on
Gender related opportunities	• Hustler fund opportunities exist for women and youth to acquire the required credit for implements and inputs required • Employment opportunities for youths exist in formulating rations for sale
VMG issues and concerns in	• VMGs have less access to agricultural information, technology and knowledge.

dissemination, adoption and scaling up	• VMGs may also have limited access to finances to buy the required inputs for feed rations formulation • VMGs may have limited access to education, training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required knowledge and credit • Employment opportunities for VMGs exist in formulating rations for sale
E: Case studies/profiles of success stories	
Success stories	• Dairy farmers trained in Murang'a and Machakos Counties on County specific feed formulation • The technology has been promoted during ToT training of all KCSAP dairy value chain counties.
Application guidelines for users	1. Technical training manual (Muia, J.M.K., Kariuki, I.W., Kanegeni, N.N., Ngae, G.N., Kariuki, J.N., Muinga, R.W., Gachuiri, C.K. and Mbugua. P.N. 2014. Total mixed rations for dairy cattle in Machakos County. Kenya Agricultural Research Institute, Nairobi, Kenya) 2. Technical training manual (Muia, J.M.K., Kariuki, I.W., Kanegeni, N.N., Ngae, G.N., Kariuki, J.N., Muinga, R.W., Gachuiri, C.K. and Mbugua. P.N. 2014. Total mixed rations for dairy cattle in Murang'a County. Kenya Agricultural Research Institute, Nairobi, Kenya.)
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires Validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Email: director.dri@kalro.org
Lead organization and scientists	KALRO J.M.K. Muia, P.T. Leparmarai, I. Kariuki, N.N. Kanegeni, G. Gachuiri, P. Mbugua, R. Muinga and , J.N. Kariuki
Partner organizations	University of Nairobi, Murang'a and Machakos Counties livestock Officers

Gaps:

a) Test and validate suitable feed ration formulations based on locally available ingredients in selected dairy counties
b) Economic analysis of feed ration formulation
c) Economics of feed formulated rations based on animal productivity

2.4.2 Early weaning milk replacer diet

2.4.2 TIMP name	**Early weaning milk replacer diet**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Sloow growth and high mortality of bull calves due to poor calf feeding occasioned by high cost of milk
What is it? (TIMP description)	Milk replacer diet formulated without milk by mixing energy and protein concentrates as well as minerals in defined proportions to meet growth requirements of bull calves. .  Formulating a milk replacer diet for bull calves  *Calf feeding on milk replacer diet*
Justification	Use of early calves' weaning diets as milk replacer on dairy-bull calves is a cheaper option for rearing dairy bull calves and can improve growth rates of calves compared to feeding expensive whole milk.. The formulation can be made from easily available local ingredients. The use of this technology improves calf growth performance and reduces calf mortality.

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small and medium scale dairy farmers, extension personnel, agripreneurs, researchers, service providers
Approaches used in dissemination	• Farmer field and business Schools (FFBS) and Farmer group training. • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Favorable milk prices and reliable markets • Availability of quality ingredients for formulation of milk replacers • Capacity building of farmers interested in this technology
Partners/stakeholders for scaling up and their roles	• The county government livestock extension staff – Training of farmer groups and collecting feedback information required by researchers on the uptake and impact of the technology • Researchers KALRO– Further research, knowledge sharing and dissemination; provide laboratory services, train trainers and provide technical backstopping on dissemination of feed formulation technologies • The National Government SDLMoALD – Policy, legal and regulatory guidelines • The private organization (NGOs, CBOs, FBOs) extension staff – Train farmer groups and will also provide the required inputs to farmers and information on the technology to researchers • KEBs and AKEFEMA – Standardization and quality regulatory guidelines • students to participate in the training of trainers, provide laboratory services and in further research to fine-tune and adapt the technologies. • The local MSMEs – Mass production, packaging and supply of cost-effective feed rations for the use by the dairy farming community

C: Current situation and future scaling up	
Counties where already promoted if any	Bungoma, Siaya, Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	All dairy production counties including Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in development and dissemination	Availability and cost of the fortified diets consisting of effective microorganisms, diamond V and diatomite
Recommendations for addressing the challenges	Private sector involvement in availing ingredients for making the milk replacer at affordable cost
Lessons learned	• Based on the information from the on-station demonstrations, it is recommended that this technology be shared with interested farmers • The technology will encourage farmers to raise dairy bull calves as opposed to eliminating them
Social, environmental, policy and market conditions necessary for development and upscaling	• Farmers' willingness to engage in training programs and embrace the technology • Availability of quality ingredients and milk replacers • An effective regulatory framework to ensure the safety and quality of milk replacers and calf feeds, including adherence to standards and labeling requirements • Implementation and knowledge of policies that promote adherence to quality control and safety standards in calf nutrition • Certification and inspection procedures to help farmers comply with early weaning diet requirements • A stable and growing market demand for high-quality dairy animals that can drive the adoption of early calves' weaning diet technology • The technology will also offer market opportunities for veal from dairy bull calves
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of milk replacer is KES.10/lt. A calf consumes 203lts of gruel from 20 days to weaning age at 3 months. Total cost of gruel consumed is KES2,030
Estimated returns	The estimated returns (gross margin) is KES 8,120/- based on the amount of milk saved by the farmer for using milk replacer to rear dairy bull calves from the first week to 3 months (KES 10,150 – 2,030 = 8,120).

Gender issues and concerns in development, dissemination, adoption and scaling up	• Feed formulation is perceived to be a technology for the well-learned persons likely to exclude women and youth • The technology is acceptable and easy to upscale by males, females and the youth • Men attend most of the training activities far from home since women and youth are involved in other demanding household activities and roles.
Gender related opportunities	• Affirmative action opportunities exist for women and youth to acquire the required knowledge and inputs • Employment opportunities for youth exist in formulating the diets
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have limited access to education, training and extension services on this technology • Due to their social status VMGs are often excluded from decision making in development and dissemination activities, hence low adoption • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required information and credit for formulation of the diets • Increased opportunities for income from sale of bull calves • Employment opportunities for youths exist in formulating the diets
E: Case studies/profiles of success stories	
Success stories	The technology has been promoted during ToT training of all KCSAP dairy value chain counties.
Application guidelines for users	Syomiti M. Leaflet on Weaner calves at 30 days EAAPP documents
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires Validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRO Mtwapa. P.O Box 16-80109, Mtwapa email: karimtw@kari.org Tel:
Lead organization and scientists	KALRO Syomiti M., M. Bauni, I. W. Kariuki, D. K. Wamae, C. Gachuiri, S. Mutua and D. Malala

Partner organizations	University of Nairobi, Feeds Co Ltd and MoALD

Gaps

1. Determine the consistency and shelf life of the essential microorganism used in fortified early calf weaning diets
2. Validate, upscale and commercialize the diets on-farm
3. Establish community-based bull-calf rearing and fattening/finishing agribusiness units based on 'best-bet' technologies among the unemployed youths

2.4.3 Maize silage based total mixed rations (TMR) for weaner dairy calves

2.4.3 TIMP name	Maize silage based total mixed rations (TMR) for Weaner dairy calves
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problems to be addressed	Low growth rate of weaner dairy calves in the dry season due to high cost and poor quality of weaner dairy calf feeds
What is it? (TIMP description)	
Justification	Weaner dairy calves are vital for the future of the dairy industry, yet they often receive insufficient attention, particularly regarding their feeding. As a result, their rearing period can extend to a costly 40 to 47 months due to poor feeding. This increases feed expenses substantially and contribute to high methane gas emission by weaner dairy calves fed poor quality dry season feeds.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Feed compounding MSMEs, farmer producer groups, agripreneurs, farmers, researchers, service providers, livestock extension officers.
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Favourable weather for forage production • Timely availability of quality feed raw materials (ingredients) • Timely training of trainers, MSMEs, farmers
Partners/stakeholders for scaling up their roles and stage of involvement	• The county government extension staff – Training of farmer groups and collecting feedback information required by researchers on the uptake and impact of the technology. • Researchers – Further research, knowledge sharing and dissemination; provide laboratory services, train trainers and provide technical backstopping on dissemination of feed formulation technologies • The National Government SDLMoALD – Policy, legal and regulatory guidelines • The private organization (NGOs, CBOs, FBOs) extension staff – Train farmer groups and provide the required inputs to farmers and information on the technology to researchers • KEBs and AKEFEMA – Standardization and quality regulatory guidelines • The local Universities – Provide students to participate in the training of trainers, provide laboratory services and be involved in further research to adapt the technologies to the realities on the ground based on feedback from the field. • Dairy co-operatives and other farmer groups – Provide inputs including land for production of dairy forages, demonstration, and research purposes • Dairy farmers – Adoption and use of the technology to improve milk production at farm level. • The local MSMEs – Mass production, packaging and supply of cost-effective feed rations for the use by the dairy farming community
C: Current situation and future scaling up	
Counties already promoted if any	-
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Inadequate/unavailability of feed raw materials (ingredients)

	• Erratic weather patterns due to climate change • High costs of feed raw materials • Poor distribution of laboratories for testing feed raw materials and feeds
Suggestions for addressing the challenges	• Use of alternative feed raw materials of good quality • Plant climate-smart forages • Involve private sector and county governments in the provision of laboratory services for analysis of the feeds • Capacity building of farmers
Lessons learned for upscaling if any	•
Social, environmental, policy and market conditions necessary for development and upscaling	• Social acceptance of the technology because it is affordable and quality feed rations which will increase milk production and reduce emission of methane to the environment. • Awareness of the benefits/advantages of the technology to enhance acceptability for increased up take. • Markets: Availability of domestic markets for the developed feed rations. • Policy: Enabling national and county government policy frameworks to guarantee affordable and quality dairy feeds.
Basic costs of the TIMPs	Not calculated
Estimated returns when using the TIMP	Not calculated
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination adoption and scaling up	• Men control the most important resources required in dairy cattle production including land and capital. Women and youth have less say in these matters. • Existing cultural practices that limit any gender categories to participate in the dairy feed value chain which allow men alone to participate • Feed formulation is perceived to be a technology for the well-learned persons. • The technology may not be adopted if the gender targeted especially women is overburdened • The technology is acceptable and easy to upscale by males, females and the youth • Men attend most of the training activities far from home since women and youth are involved in other demanding household activities and roles.

Gender related opportunities	• Develop capacity for women and youth in feed formulation to improve profitability of their dairy business. • Develop capacity for women and youth to set up MSMEs feed formulation units for feed value addition and profits • It offers opportunities in enhancing food and nutrition security with the rural households and as source of income
VMG issues and concerns in development, dissemination, adoption and scaling up	• Due to their social status VMGs are often excluded from decision making in development and dissemination • VMGs face the barrier of accessing quality dairy feeds due to inadequate resources such as land and credit • Access to sufficient maize for silage may be a challenge to some VMGs • Due to prejudices associated with their social status, VMGs are excluded from access to and benefits from improved technologies. Thus the technology is not easily adoptable by the VMGs
VMG related opportunities	• Affirmative action, capacity building and practical support to be provided • Increased production will lead to increased consumption of nutritious milk hence improved health of VMGs; • Changing consumer behavior leading to increased demand hence improved incomes for VMGs
E: Case studies/profiles of success stories	
success stories	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
Application guidelines for users	To be developed
G: Contacts	
Contacts	Centre Director, KALRO DRI Naivasha. P.O Box 25 20117 Naivasha email: karinaivasha@kari.org Tel: 0202122762
Lead organization and scientists	KALRO: John Muia, Naftali Kanegeni, Mathai Ndungu
Partner organizations	SDL-national and County Governments, UoN, KEBS, AKEFEMA, Dairy cooperatives, farmer groups, private organizations (NGOs, CBOs, FBOs), MSMEs

Gaps:

1. Test and validate suitable feed ration formulations based on locally available ingredients in selected dairy Counties
2. Economic analysis of calf feed ration formulation.

2.4.4 Maize silage and lupin-based TMR for lactating cows

2.4.4 TIMP name	**Maize silage and lupin-based TMR for lactating cows**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problems to be addressed	Low milk production by dairy cattle in the dry season due to high cost and poor quality of feeds for lactating dairy cattle. High methane gas emission by dairy cattle fed poor quality dry season feeds
What is it? (TIMP description)	This is a technology on feeds for lactating dairy cows developed using the milk cow module of the PCDairy2005 feed formulation software. The developed feed rations are least-cost, nutrient balanced and can support target milk production in addition to other requirements of the cow including its maintenance. The developed and tested dry season feed rations for lactating dairy cows are: - 1. Maize silage supplemented with dairy meal concentrate (MSD) 2. Maize silage supplemented with a lupin seed meal-based concentrate (MSL) 3. Maize silage supplemented with a poultry waste-based concentrate (MSP)
Justification	A baseline survey in Kenya revealed low average daily milk yields of 6.7 kg per dairy cow, largely attributed to the high costs of feeds, constituting over 60% of total production expenses, and subpar dairy cattle nutrition. High methane gas emission by dairy cattle fed poor quality dry season feeds. On the other hand, there is a surging demand for milk driven by population growth, rising incomes, and urban consumers' preference for high-quality food. This requires development of gender-sensitive, cost-effective, and eco-friendly technologies to boost milk production during the dry season.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Feed compounding MSMEs, farmer producer groups, farmers, researchers, service providers, livestock extension officers
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) and Farmer group training. • Agricultural Innovation Platforms (AIP)

	• Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesAgricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	• Favourable weather for forage production • Timely availability and good quality of feed raw materials (ingredients) • Timely training of trainers, MSMEs, farmers • High demand for the technology • Reliable access to high quality and nutritious ingredients is necessary.
Partners/stakeholders for scaling up their roles and stage of involvement	• The county government SDL extension staff – training of farmer groups and collecting feedback information required by researchers on the uptake and impact of the technology. The researchers will intervene when necessary to improve on technology uptake and impact at farm level. • The National Government SDL – for policy, legal and regulatory guidelines • The private organization (NGOs. CBOs, FBOs) extension staff – trainers of farmer groups and will also provide the required inputs to farmers and information on the technology to researchers. • KEBs and AKEFEMA – for standardization and quality regulatory guidelines • The local Universities (UoN) – provide students to participate in the training of trainers and will also provide laboratory services and be involved in further research to fine-tune and adapt the technologies to the realities on the ground based on feedback from the field. • The dairy co-operatives and other farmer groups – provide inputs including land for production of dairy forages, demonstration, and research purposes • Research Organizations – provide laboratory services, train trainers and provide technical backstopping on dissemination of feed formulation technologies

	• Dairy farmers – Adoption and use of the technology to improve milk production at farm level. • The local MSMEs – Involved in mass production, packaging and supply of cost-effective feed rations for the use by the dairy farming community
C: Current situation and future scaling up	
Counties already promoted if any	The technology is yet to be promoted but scaling up will be done in all dairying counties in Kenya.
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Inadequate/unavailability of feed raw materials (ingredients) including quality • Erratic weather patterns due to climate change • High costs of feed raw materials • Poor distribution of laboratories for testing feed raw materials and feeds
Suggestions for addressing the challenges	• Look for alternative feed raw materials • Plant climate-smart forages • Involve private sector and county governments in the provision of laboratory services • Capacity building of farmers
Lessons learned for upscaling if any	-
Social, environmental, policy and market conditions necessary for development and upscaling	**Social:** • Farmers' willingness to engage in training programs and embrace the technology TIMP in place • Social acceptance of the technology because it is affordable and quality feed rations which will increase milk production and reduce emission of methane to the environment. • Awareness of the benefits/advantages of the technology to enhance acceptability for increased up take. **Environmental** • Proper storage facilities and quality control measures to maintain the freshness and nutritional value. • Proper waste disposal systems to manage waste generated during feed preparation and feeding. **Market** • Ensuring the availability of maize silage and lupin-based feed ingredients for effective formulation of TMR.

	• Availability of domestic markets for the developed feed rations: • A stable and growing market demand for high-quality dairy products can drive the adoption of TMR technology. **Policy** • Enabling national and county government policy frameworks to guarantee affordable and quality dairy feeds. • An effective regulatory framework to ensure the safety and quality of feed ingredients and TMR, including adherence to standards and labeling requirements.
Basic costs of the TIMPs	The basic cost of formulating the TMR is KES387.40/cow/day which includes the cost of ingredients, labour and other incidental costs.
Estimated returns when using the TIMP	Lactating cows fed on this ration have the potential of yielding up to 15litres/cow/day with an estimated gross income of KES750/cow/day. Comparatively a farmer using maize silage and dairy meal will get the same yield but at a higher cost.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology may not be adopted if the gender targeted especially women is overburdened • Men attend most of the training activities far from home since women are involved in other demanding household activities and roles • Women have less access to credit to buy the required inputs • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Hustler funds opportunities exist for women and youths to acquire the required credit • Employment opportunities for youths exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • VMGs may also have limited access to finances to buy the required inputs • VMGs may have limited access to materials required for silage production • VMGs have limited access to education, training and extension services.

	• Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit • Maize silage and lupin-based TMR preparation may provide income opportunity for VMGs • Employment opportunities for youths exist in performing the task
E: Case studies/profiles of success stories	
success stories	
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	To be developed
G: Contacts	
Contacts	Centre Director, KALRO DRI Naivasha. P.O Box 25 20117 Naivasha email: karinaivasha@kari.org
Lead organization and scientists	KALRO: John Muia, Naftali Kanegeni, Mathai Ndungu
Partner organizations	SDL-national and County Governments, UoN, KEBS, AKEFEMA, Dairy cooperatives, farmer groups, private organizations (NGOs, CBOs, FBOs), MSMEs

Gaps

1. Future work should include the validation of the technologies on-farm to recommend what works best at farm level
2. More dry season feed rations need to be evaluated including crop residues and high-protein forages and non-conventional feeds such as insect-based supplements

2.4.5 Rhodes grass hay and lupin based TMR for lactating dairy cows

2.4.5 TIMP name	**Rhodes grass hay and lupin based TMR for lactating dairy cows**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problems to be addressed	Low milk production by dairy cattle in the dry season due to high cost and poor quality of dairy feeds
What is it? (TIMP description)	This is a technology where Rhodes grass hay and lupins are used to formulate feed rations that are least-cost, nutrient balanced and can support target milk production in addition to other requirements of the cow including its maintenance. The developed and tested dry season feed rations for lactating dairy cows are: 1. Rhodes grass hay supplemented with dairy meal concentrate 2. Rhodes grass hay supplemented with lupin seed meal based concentrate 3. Rhodes grass hay supplemented with poultry waste based concentrate
Justification	hodes grass ahy is easily available in Kenya. Similarly, Lupins can be grown in many bean growing areas. Ration based on the two forage crops can assist reduce on costs of feeding and contribute to reduction of methane gas emission by dairy cattle fed poor quality dry season feeds.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Feed compounding MSMEs, farmer producer groups, farmers, researchers, service providers, livestock extension officers.
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) and Farmer group training. • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesAgricultural Innovation Platforms (AIP)
Critical/essential factors for successful promotion	• Favourable weather for forage production • Timely availability of feed raw materials (ingredients) • Timely training of trainers, MSMEs, farmers • High demand for the technology
Partners/stakeholders for scaling up their roles and stage of involvement	• The county government SDL extension staff – training of farmer groups and collecting feedback information required by researchers on the uptake and impact of the

	technology. The researchers will intervene when necessary to improve on technology uptake and impact at farm level. • The National Government SDL – for policy, legal and regulatory guidelines • The private organization (NGOs. CBOs, FBOs) extension staff – trainers of farmer groups and will also provide the required inputs to farmers and information on the technology to researchers. • KEBs and AKEFEMA – for standardization and quality regulatory guidelines • The local Universities (UoN) – provide students to participate in the training of trainers and will also provide laboratory services and be involved in further research to fine-tune and adapt the technologies to the realities on the ground based on feedback from the field. • The dairy co-operatives and other farmer groups – provide inputs including land for production of dairy forages, demonstration, and research purposes • Research Organisations – provide laboratory services, train trainers and provide technical backstopping on dissemination of feed formulation technologies • Dairy farmers – Adoption and use of the technology to improve milk production at farm level. • The local MSMEs – Involved in mass production, packaging and supply of cost-effective feed rations for the use by the dairy farming community
C: Current situation and future scaling up	
Counties already promoted if any	-
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Inadequate/unavailability of feed raw materials (ingredients) • Erratic weather patterns due to climate change • High costs of feed raw materials • Poor distribution of laboratories for testing feed raw materials and feeds
Suggestions for addressing the challenges	• Look for alternative feed raw materials • Plant climate-smart forages

	• Involve private sector and county governments in the provision of laboratory services • Capacity building of farmers
Lessons learned for upscaling if any	None
Social, environmental, policy and market conditions necessary for development and upscaling	**Social** • Social acceptance of the technology because it is affordable and quality feed rations which will increase milk production and reduce emission of methane to the environment. • Farmers' willingness to engage in training programs and embrace the technology • Reliable access to high-quality and nutritious ingredients. • Proper storage facilities and quality control measures to maintain the freshness and nutritional value. • Environmentally friendly agricultural practices for long-term availability of feed ingredients without causing harm to the environment. • Awareness of the benefits/advantages of the technology to enhance acceptability for increased up take. **Market** • Availability of domestic markets for the developed feed rations. • Ensuring the availability of Rhodes grass hay and lupin-based feed ingredients for the effective formulation of TMR. **Policy** • Enabling national and county government policy frameworks to guarantee affordable and quality dairy feeds. • An effective regulatory framework to ensure the safety and quality of feed ingredients, including adherence to standards and labeling requirements.
Basic costs of the TIMPs	The basic cost of formulating the TMR is KES297.12/cow/day this includes the cost of ingredients, labour and other incidental costs.
Estimated returns when using the TIMP	Lactating cows fed on this ration have the potential of yielding up to 12litres/cow/day with an estimated gross income of KES600/cow/day. Comparatively a farmer using Rhodes grass and dairy meal will get 13litres/cow/day but at KES330.57.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to agricultural information, technology and knowledge • Women have limited access to education, training and extension services. • Women have less access to credit to buy the required inputs • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities for youths exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs have less access to agricultural information, technology and knowledge • Access to good quality hay at affordable price may be a challenge for VMGs • VMGs may also have limited access to finances to buy the required inputs • VMGs have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit • Opportunity to get involved in dairy value chain by VMG through production of • Employment opportunities for youths exist in performing the task
E: Case studies/profiles of success stories	
success stories	-
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
Application guidelines for users	To be developed
G: Contacts	
Contacts	Centre Director, KALRO DRI Naivasha. P.O Box 25 20117 Naivasha email: karinaivasha@kari.org Tel: 0202122762

Lead organization and scientists	KALRO: John Muia, Naftali Kanegeni, Mathai Ndungu
Partner organizations	SDL-national and County Governments, UoN, KEBS, AKEFEMA, Dairy cooperatives, farmer groups, private organizations (NGOs, CBOs, FBOs), MSMEs

GGaps

1. Future work should include the validation of the technologies on-farm to recommend what works best at farm level
2. More dry season feed rations need to be evaluated including crop residues and high-protein forages and non-conventional feeds such as insect based supplements

2.4.6 Improved Probiotics for dairy cattle (KALPRO)

2.4.6 TIMP name	**Improved Probiotics for dairy cattle (KALPRO)**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Low productivity of dairy animals due to low quality and quantity of feed and fodder
What is it? (TIMP description) 	Improved probiotics or KALPRO is a Nutritional supplement that is administered to dairy animals (Large and small ruminants) to enhance their digestibility as well as the absorption of Nutrients that is further translated into products such as Milk and Meat. It also enhances the immune system of the dairy animals by improving the production of immune-boosters such as β and α interferon's, hence increasing the animal resilience to pests and diseases.  *A bottle of KALPRO* *Source: KALRO VSRI*
Justification	Considering low animal productivity despite increasing demand for animal products, ther is need for non antibiotics and growth promotants to enhance nutrient intake and productivity. Use of KALPRO decreases morbidity and mortality, improve feeding behavior and increase production (meat, milk) yield.
B: Assessment of dissemination and scaling up/out approaches	

Users of the TIMP	All Dairy farmers for both Large and small ruminants who are practicing dairy animal production as their source of income
Approaches to be used in dissemination	• Farmer field and business Schools (FFBS) and Farmer group training. • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message servicesFarmer-to-farmer extension,
Critical/essential factors for successful promotion	• Functional regional centers for sustainable supply Probiotics • Functional and effective Probiotics distribution channels • Awareness and access to information on use of the probiotics • Extension service providers (Public and private) will offer advice and collect information on the uptake of the probiotics. They will also ensure the proper use of the product • County Governments; promote and create awareness of the advantages of the improved probiotics • Improved Policy and regulation on the use of the Probiotics to combat climate change. • Farmers and farmer groups; will spread information on the improved probiotic and provide their farms as demo stations • Incorporation of animal health product regulators (VMD, DVS, NACOSTI, the Kenya Veterinary Board (KVB) into the DIVA vaccine commercialization process • Assigned stockiest KALRO and Partners to ensure distribution and availability of the product. • Packaging and cost benefit analysis of the product
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) • To train farmers on utilization of the improved probiotics as well as and monitor implementation • KALRO – Technology development and fine tuning, ToT, backstopping and monitor implementation • Animal Production Society of Kenya (APSK) - Maintain records of the production and adoption of the technology by the farmers.

	• Farmer organizations – Disseminate information to member on the availability of the technology • Dairy cooperative societies – Disseminate information and avail product to dairy farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Parts of Kajiado and Taita Taveta counties
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia.
Challenges in dissemination	• Lack of awareness by the farmers and other stakeholders in the dairy industries • Inadequate Probiotics distribution network • Lack of marketing and distribution channels for the Probiotic to farmers • Lack of good production and marketing model for the improved probiotics • Lack of training for the extension staff and the lead farmers on the use and management of the improved Probiotics • Lack of established farmer learning centers
Suggestions for addressing the challenges	• Sensitization of farmers about the Probiotics • Capacity building of farmers and service providers in the Dairy value chain • Documentation of Innovation • Training on the use and benefits of the innovation to livestock keepers. • Create regional Probiotics distribution channels • Working with partners (farmers, farmer groups, county governments, agrovets) with comparative advantage will ensure the success of probiotics • Establishment of proper distribution channels for the product as well as creation of awareness
Lessons learned in up scaling if any	• This is a new technology that needs up scaling.
Social, environmental, policy and market conditions necessary for development and upscaling.	• Social: Awareness and acceptance of the improved Probiotics (KALPRO) for increase in production as well as reduction in the production cost. • Market: Good milk market and value addition to cater for increased production Good milk market and value addition to cater for increased production • Policy: Need for policy to guide the incorporation of the Improved probiotics in the dairy production and its utilization in the country and the region

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	230Kes/ltr of the probiotic
Estimated returns	-30% increase in milk and meat production hence 30% increase in income.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Often, women and youth lack access to the service and input delivery systems in livestock production, which are male dominated • Lack of access and control could be attributed to cultural norms which deny women/ youth the privileges • Despite their role in livestock production, women's control has traditionally declined when productivity increases • Women are disadvantaged when livestock and products are especially marketed in organized groups whose membership is predominantly men • Women and youth have limited access to livestock markets technology • information and awareness flow to female farmers may be slow due to low education levels
Gender related opportunities	• Milk has high local demand and therefore offers an opportunity for women and youth who are mostly involved in marketing • Need to have gender friendly training materials with illustrations to enhance communication to all gender • Proper timing of agricultural-related meetings will allow participation by all the gender categories • Have well organized gender friendly markets and marketing system • Increased milk production hence improved household nutrition, increased income
VMG issues and concerns in development and dissemination	• Milk and meat are important for health and there is need to target KALPRO for dissemination • Target KALPRO for upscaling activities with the VMG and ensure their animals are included in scaling from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Milk nutrition is important for health and there is need to target VMGs for dissemination • Target VMGs for ART up scaling activities and ensure they have rights to access capital assets e.g. land and livestock • Increased milk production hence improved nutrition and increased income from dairy agribusiness activities.

	• VMGs can form common interest groups for collective access to the probiotics and enter into the distribution chain for income generation • Probiotic adoption, and access to distribution channels will lead to increased animals' productivity hence increased incomes and improved food and nutrition security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	All Farmers who have used the improved probiotic have recorded an increase in milk production, improved body index increased resistance to diseases and increased income. Kanyaya farm in Kajiado, a farmer in Meru, Kisumu Eldoret alongside others
Application guidelines for users	Users guide and manual (Improved Probiotics guide for enhanced productivity in dairy cattle production)
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	The Centre Director, KALRO-BioRI, Kabete P.O Box 14733-00800 Nairobi Email: director.biotech@kalro.org Tel: +254 721931158
Lead organization and scientists	KALRO-BioRI-Kabete; Mr. Willis Adero KALRO-BioRI-Muguga Martin Mwirigi, KALRO-BioRI-Kabete: Harrison Lutta, KU: Purity Nguhiu, KEVEVAPI: Jones Mutua, KALRO-BioRI: Stella Makokha, Stephen Ger Nyanjom.
Partner organizations	MOALD, Kenyatta University, JKUAT, DVM, APSK.

Gaps:

1. Need to register the product
2. Need to develop a policy guide that will instill the utilization of the utilization and adoption of the improved probiotics for increased productivity and resilience to climate change
3. Establishment of distribution channels that will allow the adoption and utilization of the improved probiotics (KALPRO)

2.4.7 Crop Residue based Total Mixed Ration (TMR)

2.4.7 TIMP name	Crop Residue based Total Mixed Ration (TMR)
	 

	Crop residue based total mixed ration
Category (i.e. Technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Inadequate quality feeds during the dry seasons leading to reduced milk production and reduced income from milk production
What is it? (TIMP description)	This is a nutritive balanced crop residue based total mixed ration feed block. It contains all major nutrients including proteins, energy and minerals for increased milk production. TMR has molasses to increase energy content and improve palatability; and urea to increase protein nitrogen.  Crop residue based total mixed ration block maker machine
Justification	rop residue-based compacted total mixed ration (TMR) is a well balanced feed that can be used for enhanced milk production. By using crop residues as a key component, it offers a practical solution to the issue of inadequate feed quality..
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Groups of smallholder farmers sharing a block compacting machine, medium and large-scale dairy farmers, Extension Agents, Service providers, researchers
Approaches used in dissemination	• Farmer field and business Schools (FFBS) and Farmer group training. • Agricultural Innovation Platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print

	• Publications -posters/brochures/leaflets, manuals • Platforms– Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of compacting machine and molasses • Availability of forage chopper and pulverizers
Partners/stakeholders for scaling up and their roles	• KALRO to train trainers and provide technical services • Extension service providers (County, NGOs, FBOs) – To train farmer groups • MSMEs – to fabricate the total mixed ration block maker machine • Dairy farmers and farmer groups – adoption of the technology
C: Current situation and future scaling up	
Counties where already promoted if any	Kisumu - Seke Dairy farmers cooperative, Elgeyo Marakwet, Trans Nzoia Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in development and dissemination	• Unavailability and high cost of the compacting machine • Inadequate quality feeds during the dry seasons • Crop residue being used as mulch in conservation agriculture (CA) limiting its availability as feed for livestock • Availability of forage chopper and pulverizers • High prices of feed ingredients (of good quality) during the dry seasons
Recommendations for addressing the challenges	• Engage and train *Jua kali* artisans to fabricate compacting machines. • The blocks are preferred by the livestock and the cost per unit is low and could easily be prepared and sold by groups • Favorable price of feed ingredients • Attractive market prices of milk • Bulk purchase of ingredients as CIGs
Lessons learned	• The blocks are preferred by the livestock and the cost per unit is low and could easily be prepared and sold by groups
Social, environmental,	**Social:**

policy and market conditions necessary	• Farmers' willingness to engage in training programs and embrace the technology • Community endorsement of the technology **Environment** • Environmentally friendly agricultural practices, including sustainable crop residue management to ensure the availability of feed ingredients without causing harm to the environment. • Proper waste disposal systems to manage by-products generated during feed preparation and feeding. **Market:** • Favorable price of feed ingredients • Attractive market prices of milk • Improve feed utilization hence reduced GHG emissions **Policy** • An effective regulatory framework to ensure the safety and quality of crop residues used in TMR, including adherence to standards and safety requirements. • Understanding of existing policies that promote adherence to quality control and safety standards in TMR formulation to ensure the production of high quality and nutritious feed.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated price of KES 15 per Kgs and a dairy cow weighing 300 Kgs requires 2 blocks of 5 Kgs each daily
Estimated returns	Can increase milk production per cow per day by 5lts from 7lts -12lts with a return of KES 200 per cow per day.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women have limited access to TMR blocks technology, information and knowledge • Women have limited access to education, training and extension services. • Women have less access to credit to buy the required inputs • The TMR block maker machine may be unavailable for women • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities for youths exist in owning the TMR block maker machine and providing the TMR
VMG issues and concerns in	• VMGs have less access to TMR block maker machine information and knowledge

dissemination, adoption and scaling up	• VMGs may also have limited access to finances to buy the required inputs and TMR block maker machine • VMGs have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit to access the technology • Employment opportunities for VMGs exist in providing the TMR blocks to dairy farmers
E. Success stories	
Success stories	The technology has been promoted during ToT training of all KCSAP dairy value chain counties.
Application guidelines for users	To be developed
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires Validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO Kakamega
Lead organization and scientists	KALRO: Okitoi, L. and Munyasi, J.
Partner organizations	Sigalagala Technical College

Gap:

1. Requires on-farm validation for more crop residues available in different agro-ecological zones

2.5 Value Addition

2.5.1 Pasteurized dairy cattle milk

2.5.1 Technology name	**Pasteurized dairy cattle milk**
Category (i.e. Technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem addressed	• Low prices of raw milk • Post-harvest milk losses due to lack of ready market • Foodbone hazards associated with consumption of raw milk
What is it? (TIMP description)	Asteurization is a process in which milk is subjected to heat treatment to eliminate bacteria which cause spoilage and spread foodborne diseases such as *Coxiella burnetti* which cause Q fever and *Mycobacterium bovis*. Although ppasteurization destroys microorganisms and enzymes that cause milk spoilage and those which are responsible for food borne illnesses, it does not eliminate most bacterial spores which may be present in milk. Milk is pasteurized using the Batch method at 63ºC for 30 minutes. Similarly, milk may be pasteurized at high temperature (72^{o}C) for 15 seconds also called short time method (HTST) or flash pasteurization.
Justification	Raw milk not only fetches relatively low income but is also highly perishable with high post-harvest losses. Lack of ready market for raw milk worsens during seasons of milk glut. Pasteurization thus addresses this challenges by ensuring the value of pasteurzied milk increases with a profit of almost 10% realized. Pasteurized milk can be preserved for up to 6 months depending on the processing method and packaging used. Pasteurization destroy or deactivate microorganisms and enzymes that contribute to food spoilage or risk of disease.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, farmer groups, dairy entrepreneurs, county extension officers, agri-preneurs and researchers
Approaches used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms– Website, Dashboards, Apps, social media short message services • Agricultural Innovation Platforms (AIP)

Critical/essential factors for successful promotion	• Consumer awareness and preferences for safe and high-quality dairy products • Appropriate training on pasteurization • FAccess to markets that value pasteurized milk • and are wWilling to pay slightly higher prices for pasteurized milk
Partners/stakeholders for scaling up and their roles	• Kenya Dairy Board - Regulations on milk handling and sale • Public health - Provision of medical and premise certificates • Cooperatives - Providing market and aggregation services • Extension service providers - Training and capacity building • Kenya Bureau of Standards (KEBS) - Quality Standards and certification • Farmer groups - Provide markets among members internally and also advertise to external markets • County governments - Support in group formation to to undertake milk pasteurization services. • Milk processors- process milk into different products.
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri, Garissa, Bomet, Siaya
Counties where TIMP will be upscaled	ilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Inadequate extension and trainers at the county-level • Preference for raw milk consumption in rural areas • Inadequate awareness on the benefits of pasteurized milk
Recommendations for addressing the challenges	• County governments should liaise with other stakeholders for extension and training • CSensitization on the food safety hazards associated with consumption of raw milk • Develop promotional materials to create awareness and influence attitude change on pasteurized milk
Lessons learned	1. Pasteurization increases shelf-life and reduces post-harvest losses

	2. Pasteurized milk attract better prices compared to raw milk
Social, environmental, policy and market conditions necessary for development and up-scaling	• FWillingness to adopt milk processing practices to minimize consumption of raw milk • Adherence to proper waste management for a safe environment for milk handling • There is an effective regulatory framework to enforce milk pasteurization standards for compliance with safety and quality regulations. • Farmers understanding of policies that promote adherence to quality control and safety standards. • Implementation of certification and inspection procedures to help farmers comply with pasteurization requirements • Good milk market: A stable and growing market demand for pasteurized milk. • reating market linkages and value addition opportunities can incentivize farmers to adopt this technology.Adherence to proper waste management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per litre of pasteurized milk is between KES 50 and KES 80 per litre
Estimated returns	Selling price per litre of pouched pasteurized cow milk is between KES 100 to 120 with a net return of between KES 50 to 60 per litre for cow milk.
Gender issues and concerns in development, dissemination and adoption and scaling up	• Women may have limited access to resources such as dairy cattle and land • Women may have limited access to information, technology and knowledge on value addition in milk • Women and youth may have limited access to education, training and extension services. • Women and youths may have limited access to credit to purchase required equipment
Gender related opportunities	• Employment opportunity exist for women and youth in the sale pasteurized milk. • Hustler funds exist for women and youth to access the required credit
Volunerable and Marginalized groups (VMGs) issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have limited access to information and knowledge on how the technology • VMGs have limited access to training and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness

VMG related opportunities	• Financial inclusion funds such as hustler funds exist for women and youth to access the required credit • Employment opportunity exist for women and youth in the sale of pasteurized milk
E: Case studies/profiles of success stories	
Success stories	Because of adopting pasteurization, raw milk which KALRO-Dairy Research Centre Ol Joro Orok sold to creameries at between KES 17 and KES 27 in 2019a litre now is sold at KES 70 per litre.
Application guidelines for users	Milk value addition farmer booklet is available at KALRO Ol Joro Orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol Joro Orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	N.N Kanegeni, E. Macharia and N. Mathai
Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

2.5.2 Yoghurt

2.5.2 TIMP name	**Cattle Yoghurt**
Category (i.e. Technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Low prices of raw milk • Post-harvest milk losses due to lack of ready market • Inadequate knowledge on diverse milk value-added products • Digestive related disorders and mineral nutrients deficiency
What is it? (TIMP description)	Yogurt is one of the fermented cattle milk products that is fermented within optimum growth temperatures of 35-45ºC. Yoghurt is made after pasteurizing cattle milk to destroy or deactivate microorganisms and enzymes that contribute to food spoilage or risk of disease.The pasteurized milk is then cultured

	with with a variety of lactic acid-producing, heat-tolerant bacteria such as *Lactobacillus delbrucaii bulgaricus,* and *Streptococcus thermophilus* to form yoghurt. Many other lactic acid producing bacteria may be used to make yogurt. Fermentaion turn lactose (sugar in milk) into lactic acid giving yoghurt giving yogurt its characteristic tangy flavor and thick texture. Yoghurt comes in various forms such as plain, flavored, Greek yogurt (strained for extra thickness), and dairy-free alternatives (like coconut or almond yogurt). The bacteria used for yoghurt production are have beneficial health benefits (probiotics) and are good for the improvement of gut microbiota and improves digestion.  ***Yoghurt from KALRO Oljoro Orok*** Source: KALRO
Justification	Raw milk fetches relatively low income and with the rising cost of production, the profit margin continues to narrow. Due to the perishability of raw milk, post-harvest milk losses is also common due to lack ready market for the raw milk which even worsen when there is a milk glut. When raw milk is processed to become yoghurt, there is over 40% profit realization. Similarly, the shelf-life increases to 45 days depending on the processing method and packages used. Yoghurt is made after pasteurizing milk to destroy or deactivate microorganisms and enzymes that contribute to food spoilage or risk of disease. The pasteurized milk is then fermented to add flavour. Yoghurt is also dense with probiotic microbes that promote digestion and essential nutrients bioavailability.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, farmer groups, dairy entrepreneurs, county extension officers, agri-preneurs and researchers
Approaches used in dissemination	• Agricultural Innovation Platforms (AIP)Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print

	• Publications-posters/brochures/leaflets, manuals • Digital Platforms – Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Consumer awareness and preferences for safe and high-quality dairy products • Appropriate training on various dairy products • Good milk market: A stable and growing market demand for yoghurt. • Understanding consumer awareness and preferences for yoghurt can help farmers produce products that meet market needs. • Educating consumers about the benefits of yogurt, including its nutritional value and health advantages, to create demand for these products.
Partners/stakeholders for scaling up and their roles	• Kenya Dairy Board - Regulations on milk handling and sale • Public health - Provision of medical and premise certificates • Cooperatives - Providing market and aggregation services • Extension service providers - Training and capacity building • KEBS - Certification and standardization • Farmer groups - Provide markets among members internally and also advertise to external markets • County governments - Support viable groups to undertake cheese value addition • Milk processors- process milk into different products.
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri, Garissa, Bomet, Siaya
Counties where TIMP will be upscaled	ilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Inadequate extension and trainers at the county-level • Preference for raw milk consumption in rural areas • Inadequate awareness on the benefits of yoghurt
Recommendations for addressing the challenges	• County governments should liaise with other stakeholders for extension and training • CSensitization on the advantages of consuming yoghurt and other processed milk products

	• Develop promotional materials to create awareness and influence attitude change on consumption of yoghurt
Lessons learned	1. There is a ready market for value added dairy products such as yoghurt 2. Yogurt is fetches better prices compared to raw milk
Social, environmental, policy and market conditions necessary	• FWillingness to adopt the practice of yoghurt making • Yoghurt should be produced under hygienic conditions for the safety of consumers • Increase awareness of the health benefits and economic opportunities associated with yogurt. • An effective regulatory framework should be in place to ensure the safety and quality of yogurt products, including adherence to hygiene and labeling standards. • Policies that promote adherence to quality control and safety standards • Understanding consumer preferences for yogurt flavors, textures, and packaging to meet market demands. • Implementation of certification and inspection procedures for compliance with yoghurt production requirements and access markets that demand safe and high-quality dairy products.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per litre of yoghurt is estimated at between KES 85 to 90 per litre. However, this may vary depending on cost of raw milk, ingredients and other consumables.
Estimated returns	Yoghurt sells at an average of KES 150 per litre translating to a net return of about KES 60/litre
Gender issues and concerns in development, dissemination and adoption and scaling up	• Women may have limited access to resources such as dairy cattle and land. • Women may have limited access to information and knowledge on processing milk into yoghurt • Women and youth may have limited access to education, training and extension services. • Women and youths may have limited access to credit to purchase required inputs
Gender related opportunities	• Employment opportunity exist for women in processing milk into yoghurt • Hustler funds exist for women and youth to access the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have limited access to information and knowledge on processing milk into yoghurt • VMGs may have limited access to training and extension services

	• Due to their social status VMGs may often get excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunity exist for women in processing milk into yoghurt • HFinancial inclusion funds such as hustler funds exist for women and youth to access the required credit
E: Case studies/profiles of success stories	
Success stories	efore KALRO - DRC Ol Joro Orok commenced yoghurt making, creameries paid KES 17-27 for a litre of raw milk produced at the centre. In 2019 after commencement of yoghurt production, the price of raw milk paid by creameries rose to KES 100-120 a litre with a profit margin of around KES 60.
Application guidelines for users	Milk value addition farmer booklet is available at KALRO Ol Joro Orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	N.N Kanegeni, E. Macharia and N. Mathai
Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

2.5.3 *Maziwa lala*

2.5.3 Technology name	***Cattle Maziwa lala***
Category (i.e. Technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Low prices of raw milk • Post-harvest milk losses due to lack of ready market • Inadequate knowledge on diverse milk value-added productsDigestive related disorders and mineral nutrients deficiency
What is it? (TIMP description)	*Maziwa lala* from cattle is a fermented dairy product that is produced through the activity of lactic acid bacteria at an optimum temperature of 25-36^{o}C. Cattle milk for production of

	maziwa lala if first pasteurized to destroy spoilage and foodborne bacteria before its fermented. *Maziwa lala* contains beneficial bacteria (probiotics) which are good for the improvement of gut microbiota and improves digestion.  ***Maziwa lala from KALRO Ol Joro Orok*** Source: KALRO
Justification	Raw milk fetch relatively low income and with the rising cost of production, the profit margin continues to narrow. Due to the perishability of raw milk, post-harvest milk losses are also happen due to lack ready market for the raw milk which may worsen during seasons of milk glut. Making m*aziwa lala* helps add value of raw milk with potential to realize profit of over 90%. Maziwa lala has a shelf-life of up to 45 days when stored stored under recommended storage conditions depending on the processing method and packaging used. *Maziwa lala* is produced from fermented milk after it is pasteurized to destroy or deactivate microorganisms and enzymes that contribute to food spoilage or risk of disease. *Maziwa lala* also contains beneficial bacteria (probiotics) that promote digestion and essential nutrients bioavailability.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, farmer groups, agri-preneursand dairy entrepreneurs
Approaches used in dissemination	• Agricultural Innovation Platforms (AIP)Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms - Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Consumer awareness and preferences for safe and high-quality dairy products • Appropriate training on making *maziwa lala* • Good milk market: A stable and growing market demand for *Maziwa lala* • Understanding consumer tastes and preferences for *Maziwa lala* helps in the production of dairy products that meet market needs. • Educating consumers about the benefits of *Maziwa lala*, including its nutritional value and health advantages, to create demand for these products.
Partners/stakeholders for scaling up and their roles	• Kenya Dairy Board - Regulations on milk handling and sale • Public Health - Provision of medical and premise certificates • Cooperatives - Providing market and aggregation services • Extension service providers - Training and capacity building • EBS - Certification and satndardization • Farmer groups - Provide markets among members internally and also advertise to external markets • County governments - Helos in forming of viable farmer groups to undertake milk value addition • Milk processors- process milk into different products.
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri, Garissa, Bomet, Siaya
Counties where TIMP will be upscaled	ilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Inadequate knowlede on diverse milk value-added products • Inadequate extension and trainers at the county-level • Preference to raw milk consumption in rural areas • Inadequate awareness on the benefits of *Maziwa lala*
Recommendations for addressing the challenges	• Create awareness about the value added milk products • County governments should liaise with other stakeholders for extension and training • Create awareness about the dangers associated with consumption of raw milk

	• Develop promotional materials to create awareness and influence attitude change on consumption of *Maziwa lala*
Lessons learned	*1.* There is a ready market for value added dairy products such as *maziwa lala* 2. *Maziwa alala* has a longer shel-life (up to 45 days) 3. *Maziwa lala* fetches better prices compared to raw milk
Social, environmental, policy and market conditions necessary for development and upscaling	• FWillingness to adopt the practice of making *maziwa lala* • Understanding consumer preferences for maziwa lala flavor, textures, and packaging to meet market demands. • Social acceptability of maziwa lala • *Maziwa lala* should be made under hygienic conditions to reduce risk of contamination with physical and microbial agents from the environment • An effective regulatory framework should be in place to ensure the safety and quality of *maziwa lala*, including adherence to hygiene and labeling standards. • Policies that promote adherence to quality control and safety standards • Implementation of certification and inspection procedures to help farmers comply with *maziwa lala* production requirements and access markets that demand safe and high-quality dairy products. • Good milk market: A stable and growing market demand for *maziwa lala*. Adherence to proper waste management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per litre of *Maziwa lala* is between KES 65 and KES 70 per litre. However, this may vary depending on cost of raw milk, ingredients and other consumables.
Estimated returns	Sales price per litre of *maziwa lala* is KES 130 with an estimated net return of between KES 60 and KES 65 per litre.
Gender issues and concerns in development, dissemination and adoption and scaling up	• Women may have less access to resources such as dairy cattle and land • Women may have less access to information and knowledge on processing milk into *maziwa lala* • Women and youth may have limited access to education, training and extension services • Women and youths may have limited access to credit to purchase required inputs
Gender related opportunities	• Employment opportunity exist for women in processing milk into *maziwa lala* • Hustler funds exist for women and youth to access the required credit

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to information and knowledge on processing milk into *maziwa lala* • VMGs may have limited access to training and extension services • Due to their social status VMGs may often excluded from decision making in development and dissemination activities • There is low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunity exist for women in processing milk into maziwa lala • Hustler funds exist for women and youth to access the required credit
E: Case studies/profiles of success stories	
Success stories	Raw milk from KALRO- DRC Ol Joro Orok was procured by creameries at as low as KES17 - 27 until 2019 when milk value addition through production of *maziwa lala* among other milk value added products was commenced. After, pasteurization, the same litre of milk is sold at KES 60-80 with a profit realization of approximately KES 43-63.
Application guidelines for users	Milk value addition farmer booklet is available at KALRO Ol Joro Orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	N.N. Kanegeni, E. Macharia and N. Mathai
Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

2.5.4 Cheese

2.5.4 Technology name	**Cheese**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low prices of raw milk, Post-harvest milk losses due to lack of ready market, Inadequate knowledge on diverse dairy value-added products, Mineral nutrients deficiency

What is it? (TIMP description)	Cheese is a dairy product produced in a range of flavors, textures, and forms by coagulation of casein (milk protein). It comprises proteins and fat from milk of cows, buffalo, goats or sheep. During production, milk is usually acidified and either the enzymes of rennet or bacterial enzymes with similar activity are added to cause the casein to coagulate. The solid curds are then separated from the liquid whey and pressed into finished cheese in the Cheese vat. A Cheese vat is a seamless stainless steel vessel or tub in which the curd is formed and cut or broken in cheese making. Some cheeses have aromatic molds on the rind, the outer layer, or throughout. Size of cheese may vary depending on milk quantities. The curd also undergoes cutting, pressing, molding and salting. Cheese is highly dense with calcium, vitamins A, D, K and zinc which contribute to bone health. Cheese is valued for its portability, long shelf life, and high content of fat, protein, calcium, and phosphorus. Cheese is more compact and has a longer shelf life than milk, although how long a cheese will keep depends on the type of cheese.  *Cheese* *Source: KALRO*
Justification	Raw milk fetch relatively low income and with the rising cost of production, the profit margin continues to narrow. Due to the perishability of raw milk, post-harvest milk losses are also high since there may not be ready market for the raw milk. This may worsen during seasons of milk glut. Making cheese, from raw milk results in profit realization of over 90% with a shelf-life of up to 14 days for the unripened cheese and up to 2 years for the ripened cheese depending on type of cheese and if storage is done under recommended storage conditions. Consumption of cheese reduces bone related conditions such as rickets and osteoporosis due to its high content of calcium, vitamins A, D, K and zinc..
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, farmer groups, dairy entrepreneurs, county extension officers, agri-preneurs and researchers
Approaches to be used in dissemination	• Agricultural Innovation Platforms (AIP)Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station

	• Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms - Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Consumer tastes and preferences for value added dairy products such as cheese • Good milk market: A stable and growing market demand for value added dairy products • Creating market linkages and distribution channels to incentivize farmers to adopt Cheese production technology. • Educating consumers about the benefits of Cheese, including its nutritional value and health advantages, to create demand for these products. • Appropriate training and demonstration sites Availability of extension services
Partners/stakeholders for scaling up and their roles	• Kenya Dairy Board - Regulations on milk handling and sale • Public Health - Provision of medical and premise certificates • Cooperatives - Providing market and aggregation services • Extension service providers - Training and capacity building • KEBS - Certification and standardization • Farmer groups - Provide markets among members internally and also advertise to external markets • County governments - Support formation of farmer and producer groups to undertake cheese production • Milk processors- Process milk into different products.
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri, Garissa, Bomet, Siaya
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in development and Dissemination	• Inadequate extension and trainers at the county-level

	• Preference to raw milk consumption in rural areas and poor altitude towards consumption of cheese • Inadequate awareness on the benefits of cheese
Recommendations for addressing the challenges	• County governments should liaise with other stakeholders for extension and training • CAwareness creation about the risk of consuming raw milk contaminated with foodborne causing bacteria. • Develop promotional materials to create awareness and influence attitude change on consumption of cheese
Lessons learned	• There is a ready market for value added dairy products products such as cheese • Cheese has a longer shel-life (up to 14 days to 2 years) • Cheese fetches better prices compared to raw milk
Social, environmental, policy and market conditions necessary	• illingness to adopt cheese • Understanding of consumer preferences for Cheese flavor, textures, and packaging to meet market demands. • Social acceptability of cheese • Adherence to proper waste management • An effective regulatory framework should be in place to ensure the safety and quality of cheese including adherence to hygiene and labeling standards. • Policies that promote adherence to quality control and safety standards • Implementation of certification and inspection procedures to help farmers comply with cheese production requirements and access markets that demand safe and high-quality dairy products. • Farmers access to markets that value Cheese and are willing to pay competitive prices for them. Adherence to proper waste management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per kg of cheese is between KES 460 and 480. However, this may vary depending on cost of raw milk, ingredients and other consumables.
Estimated returns	Sales price per kg of Cheese is about KES 1000/kg with an estimated net return of between KES 520 to 540 per kg
Gender issues and concerns in development, dissemination and adoption and scaling up	Women may have less access to resources such as dairy cattle, capital and land Women may have less access to information and knowledge on processing milk into cheese Women and youth may have limited access to education, training and extension services. Women and youths may have limited access to credit to purchase required inputs
Gender related opportunities	Employment opportunity exist for women in processing milk into cheese

	Hustler funds exist for women and youth to access the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	VMGs may have less access to information and knowledge on processing milk into cheese VMGs may have limited access to training and extension services Due to their social status VMGs are often excluded from decision making in development and dissemination activities There is low adoption by VMGs due lack of awareness
VMG related opportunities	Employment opportunity exist for women in processing milk into cheese Hustler funds exist for women and youth to access the required credit
E: Case studies/profiles of success stories	
Success stories	Creameries bought raw milk from KALRO-DRC Ol Joro Orok was for as low as KES17 - 27 a litre. This has since changed with equivalent litres (10L/1kg cheese) being sold at KES 600.
Application guidelines for users	Milk value addition farmer booklet available at KALRO Ol Joro Orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and Scientists	N.N. Kanegeni, E. Macharia and N. Mathai
Partner organizations	County government of Nyandarua, KDB, KEBS & Public health

2.5.5 Butter

2.5.5 Technology name	**Butter**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Low prices of raw milk • Post-harvest milk losses due to lack of ready market • Inadequate knowledge on diverse milk value-added products • Mineral nutrients deficiency

What is it? (TIMP description)	Butter is a dairy product made from the fat and protein components of churned cream. It is a semi-solid emulsion at room temperature, consisting of approximately 80% butterfat, maximum 2% milk solids not fat and 16% water. It is used at room temperature as a spread, melted as a condiment, and used as a fat in baking, sauce-making, pan frying, and other cooking procedures. Butter is categorized (1) According to type of cream nd include:1. According to type of cream: • *Sweet cream butter: cream from fresh milk which is acid free. Sugar is also added. • *Sour cream butter: cream is inoculated with cultures to produce lactic acid and aroma. It has the characteristic smell of diacetyl. 2. According to salt content • *Unsalted butter: no salt added • *Salted butter: Salt is added Butter is very rich in Vitamin D and calcium, nutrients vital for bone growth and development.  Butter from Source: KALRO
Justification	Raw milk fetch relatively low price and with the rising cost of production, the profit margin continues to narrow. Due to the perishability of raw milk, post-harvest milk losses are also high since there may not be ready market. The losses may worsen during milk glut season. Butter making may result in over 95% profit realization with a shelf-life of up to 2 months when stored under the recommended storage conditions. Butter has high levels of Vitamin D and calcium and so consumption of this is effective in the prevention of bone related issues such as osteoporosis and rickets.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, farmer groups, dairy entrepreneurs, county extension officers, agri-preneurs and researchers

Approaches to be used in Dissemination	• Agricultural Innovation Platforms (AIP)Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms - Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Consumer awareness about the benefits of butter including its nutritional value and health advantages to create demand. • Good milk market: A stable and growing market demand for dairy value added products • Creating market linkages and distribution channels to incentivize farmers to adopt butter production technology. • Educating consumers about the benefits of butter, including its nutritional value and health advantages, to create demand for these products. • Appropriate training and demonstration sites Availability of extension services
Partners/stakeholders for scaling up and their roles	• Kenya Dairy Board - Regulations on milk handling and sale • Public Health - Provision of medical and premise certificates • Cooperatives - Providing market and aggregation services • Extension service providers - Training and capacity building • KEBS - Certification and sandardization • Farmer groups - Provide markets among members internally and also advertise to external markets • County governments - Support formation of producer and butter processing groups to undertake value addition with Butter as the intended product • Milk processors- process milk into different products.
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri, Garissa, Bomet, Siaya

Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Inadequate extension and trainers at the county-level • Preference to raw milk consumption in rural areas and poor altitude towards butter consumption. • Inadequate awareness on the benefits of butter
Recommendations for addressing the challenges	• County governments should liaise with other stakeholders for extension and training • CCreate awareness on the dangers of consuming raw milk. • Develop promotional materials to create awareness and influence attitude change on consumption of butter
Lessons learned	• There is a ready market for value added dairy products products such as butter • Butter has a longer shel-life (up to 60 days) • Butter fetches better prices compared to raw milk
ocial, environmental, policy and market conditions necessary for development and upscaling	• Willingness to Process milk into butter • Understanding of consumer tastes and preferences for butter flavor, textures, and packaging to meet market demands. • Adherence to proper waste management • An effective regulatory framework should be in place to ensure the safety and quality of butter including adherence to hygiene and labeling standards. • Policies that promote adherence to quality control and safety standards • Implementation of certification and inspection procedures to help farmers comply with butter production requirements and access markets that demand safe and high-quality dairy products. • Good milk market: A stable and growing market demand for butter • Farmers access to markets that value butter and are willing to pay competitive prices for them. Adherence to proper waste management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per kg of butter is KES 400. However, this may vary depending on cost of raw milk, ingredients and other consumables.
Estimated returns	Sales price per kg of butter is KES 1200 with an estimated net return of KES 800 per kg. Skimmed milk can also be sold resulting in additional income.

Gender issues and concerns in development, dissemination and adoption and scaling up	• Women may have less access to resources such as dairy cattle, capital and land • Women may have less access to information and knowledge on processing milk into butter • Women and youth may have limited access to education, training and extension services. • Women and youths may have limited access to credit to purchase required inputs
Gender related opportunities	• Employment opportunity exist for women in processing milk into butter • Hustler funds exist for women and youth to access the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to information and knowledge on processing milk into butter • VMGs may have limited access to training and extension services • Due to their social status VMGs may often make them to be excluded from decision making in development and dissemination activities • There may be low adoption rates by VMGs due lack of awareness
VMG related opportunities	• Employment opportunity exist for women in processing milk into butter • Hustler funds exist for women and youth to access the required credit
E: Case studies/profiles of success stories	
Success stories	KALRO- DRC Ol Joro Orok sold raw milk to creameries for as low as KES 17 - 27 but with milk processing to make butter among other value added products, 25 l of raw milk enough to make 1 kg of butter is sold sold at Kes 900-1000. Still skimmed milk after cream separation is sold to hospitals further boosting the income from the milk.
Application guidelines for users	Milk value addition farmer booklet available at KALRO Ol Joro Orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol joro orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	N.N Kanegeni, E. Macharia, N. Mathai
Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

2.5.6 Ghee

2.5.6 Technology name	Ghee
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	• Low prices of raw milk • Post-harvest milk losses due to lack of ready market • Inadequate knowledge on diverse milk value-added products • Digestive related disorders and mineral nutrients deficiency
What is it? (TIMP description)	Ghee is a milk product obtained from butter or cream by elimination of water and solids non fats through decantation or evaporation. Its composition is equal to or more than 99% fat and < 1% water. Ghee contains high concentrations of monounsaturated Omega 3 fatty acids which possess beneficial to health as they strengthen the heart and cardiovascular system.  ***Ghee*** Source: KALRO
Justification	Raw milk fetch relatively low income and with the rising cost of production, the profit margin continues to narrow. Due to the perishability of raw milk, post-harvest milk losses are high since there is no ready market for the raw milk. This may worsen during milk glut periods. Ghee production ensures less wastage and enhances profits by over 80%. Ghee has a shelf-life of up to 6 months when stored under the recommended storage conditions. The high concentrations of monounsaturated Omega 3 fatty acids in ghee promote healthy heart and cardiovascular system and also minimizes the intake of unhealthy cholesterol.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, farmer groups, dairy entrepreneurs, county extension officers, agri-preneurs and researchers
Approaches used in Dissemination	• Agricultural Innovation Platforms (AIP)Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP)

	• Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms - Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Understanding of consumer tastes and preferences for Ghee flavor, textures, and packaging to meet market demands. • Good milk market: A stable and growing market demand for dairy value added products • Creating market linkages and distribution channels to incentivize farmers to adopt Ghee production technology. • Educating consumers about the benefits of Ghee including its nutritional value and health advantages, to create demand for these products. • Appropriate training and demonstration sites Availability of extension services
Partners/stakeholders for scaling up and their roles	• Kenya Dairy Board - Regulations on milk handling and sale • Public Health - Provision of medical and premise certificates • Cooperatives - Providing market and aggregation services • Extension service providers - Training and capacity building • KEBS - Certification and standardization • Farmer groups - Provide markets among members internally and also advertise to external markets • County governments - Support in the formation of producer and processing groups to undertake value addition with butter as the intended product
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nakuru, Nyeri, Garissa, Bomet, Siaya
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia

Challenges in dissemination	• Inadequate extension and trainers at the county-level • Preference to raw milk consumption in rural areas and poor altitude towards ghee consumption. • Inadequate awareness on the benefits of ghee
Recommendations for addressing the challenges	• County governments should liaise with other stakeholders for extension and training • Capacity building of trainers by county governments in liaison with stakeholders. • Develop promotional materials to create awareness and influence attitude change on ghee consumption
Lessons learned	• There is a ready market for value added dairy products products such as ghee • Ghee has a longer shel-life (up to 6 months) • Ghee fetches better prices compared to raw milk
ocial, environmental, policy and market conditions necessary for devlopment and upscaling	• Willingness to make ghee instead of consuming raw milk • Social acceptability of ghee • Adherence to proper waste management • Awareness of the health benefits and economic opportunities associated with ghee. • An effective regulatory framework should be in place to ensure the safety and quality of butter including adherence to hygiene and labeling standards. • Policies that promote adherence to quality control and safety standards • Implementation of certification and inspection procedures to help farmers comply with butter production requirements and access markets that demand safe and high-quality dairy products. • Good milk market: A stable and growing market demand for gheeAdherence to proper waste management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of production per kg of ghee is KES 490. However, this may vary depending on cost of raw milk and other consumables.
Estimated returns	Sales price per Kg of ghee is KES 900 with an estimated net return of KES 410 per kg.
Gender issues and concerns in development, dissemination and adoption and scaling up	• Women may have less access to resources such as dairy cattle, capital and land • Women may have less access to information and knowledge on processing milk into ghee • Women and youth may have limited access to education, training and extension services. • Women and youths may have limited access to credit to purchase required inputs

Gender related opportunities	• Employment opportunity exist for women in processing milk into ghee • Hustler funds exist for women and youth to access the required credit
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to information and knowledge on processing milk into ghee • VMGs may have limited access to training and extension services • Due to their social status VMGs may often be excluded from decision making in development and dissemination activities • There may be low adoption by VMGs due lack of awareness
VMG related opportunities	• Employment opportunity exist for VMGs in processing milk into ghee • Hustler funds exist for VMGs to access the required credit
E: Case studies/profiles of success stories	
Success stories	ALRO-DRC Ol Joro Orok sold raw milk to creameries for as low as KES 17-27 until when they commenced production of milk value added products includng ghee. Currently 1 kg of ghee made from 35 kg of milk is old for KES 750. Additionally, skimmed milk recovered after cream separation is also sold especially to hospitals further boosting the income from the milk.
Application guidelines for users	Milk value addition farmer booklet available at KALRO Ol Joro Orok.
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO Ol Joro Orok, P.O Box 200 - 20302 Ol Joro Orok Email: kalrooljk@kalro.org Mobile :0710854357
Lead organization and scientists	N.N Kanegeni, E. Macharia, N. Mathai
Partner organizations	County Government of Nyandarua, KDB, KEBS, Public health

2.5.7 Wet salting of raw hides and skins

2.5.7 TIMP Name	***Wet salting of raw hides and skins***
Category (i.e. technology, innovation or management	TManagement practice

practice)	
A: Description of the technology, innovation, or management practice	
Problem to be addressed	• High post flaying losses due poor preservation of hides and skins resulting in bacterial spoilage or damage by insects and fungi. • poor prices of raw hides and skins due to improper flaying and low demand due lack of value addition.
What is it? (TIMP description)	Wet salting is a preservation method where salt (NaCl) is applied on raw fresh hides and skins to slow down spoilage. The salt is applied on the flesh side of the hide or skin so that it assists to drain moisture from the hide or skin, saturating the salt ions in the hide matrix.
Justification	ides represent about 7.5 % of the live weight of cattle, while in goats and sheep skin account for about 9 %. It is economically prudent for slaughterhouses to add value to these by-products to enhance the economic resilience of their enterprises. Proper hide handling and preservation is therefore critical to availing materials for upstream leather production. Wet salted hides and skins may be kept for up to 12 months while being stable amid temperature fluctuations during which time the slaughterhouse management dispose of the hides and skins or process them further.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Livestock farmers, in slaughterhouse workers, hide and skin traders, agri-preneurs and tannery operators.
Approaches used in dissemination	• Public and private agricultural extension servicesFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Carry out a cost-benefit analysis for wet salting to demonstrate economic gain to the slaughterhouse management and curers. • Identify ready markets for preserved hides and skins, by identifying micro, small and medium tanneries in their catchment area and beyond. • For better retention of knowledge, training hides and skins curing champions or trainers of trainers among the slaughterhouse staff and at village levels is necessary.
Partners/stakeholders for scaling up and their roles	• KALRO- to conduct a cost-benefit analysis for wet salting to demonstrate economic gain those interested in this value addition activity.

	• Directorate of Veterinary Service (Leather Section) - to regulate industry • Kenya Industrial Research Development Institute (KIRDI) - to train tannery and slaughterhouse staff on hides and skins processing. • Kenya Leather Development Council (KLDC) – directing development and regulation of the leather industry in Kenya
C: Current situation and future scaling up	
Counties where already promoted if any	Kajiado, Nakuru, Nairobi, Kiambu, Machakos, Kilifi, Narok
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia.
Challenges in dissemination	• Low demand of the raw hides and skins • Lack of awareness in curing of hides and skins as a value addition activity. • Need to grow market for cured hides and skins to spur up-take of the technology.
Suggestions for addressing the challenges	• Sensitization and presenting the cost-benefit analysis of curing hides and skins to visualize profitability. • Create awareness on the economic benefits from hides and skins and the need to do value addition • Reduction in solid waste originating from hides and skins by the slaughterhouse. • Ensure availability of ready market at production level
Lessons learned in upscaling if any	KASAL Project: The project assessed the curing effect of various salts used for hide curing by communities in Northern Kenya across six counties. Industrial salt outperformed Chalbi salt, marine salt, table salt and livestock salt. The prices of cured skins increased by 28.5 % for the primary trader.
Social, environmental, policy and market conditions necessary for development and upscaling	• Social- Leather industry currently employs 22,000 people both directly and indirectly, and further development will spur higher employment rates (KNBS, 2016). • Environmental- Hide and skin preservation and leather tanning are a highly polluting activities and therefore sustainable upscaling of this technology should be positioned at institutions, such as NEMA-inspected slaughterhouses that practice environmental stewardship and are compliant to Effluent Discharge licensing conditions. • Policy- Policies along the hides and skins value chain should be implemented in tandem and coordination with other related policies such as those affecting livestock production, environmental conservation, good governance, inclusivity, productivity, and competitiveness. Failure to which the technology will not be sustainably upscaled. • Market conditions-Efficient assembly or aggregation of hides and

	skins needs to be improved to lower costs of collating and transporting the products. Ideally harvesting, preservation and bulking of hides and skins should be carried out in the slaughter facility to optimize preservation, and lower costs of producing wet salted products. Accessibility of county and national prices of raw and wet salted hides and skins should be availed to farmers and aggregators to enhance fair trade of the commodities.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	**NOTE 1:** The pricing of hides and skins across Kenyan livestock markets is dependent on the market location, grade of product and season. While the cost of fresh hides (II) are reported to be as low as Kes. 0.2/kg in Trans Nzoia, it is reported at Kes. 20/kg in Nanyuki, while hides (III) in Ilbissil reaches Kes. 50kg (KAMIS, 2023). However, the average price of wet salted hide is more stable, with tanneries offering between Kes. 30 - 40/kg. **NOTE 2:** A curing premise requires an annual business permit of KES. 2,500. **NOTE 3:** A dispatch note per consignment is KES. 100. Mean cost of buying fresh hide: KES. 20/kg x 15 kgs = KES. 300 Mean cost of salt for 1 hide: 15 kg x 0.3 = 4.5kg x Kes 20/kg= KES. 90 Mean cost of labour: *0.06 x KES. 300 = KES. 18 Mean cost of transport (pickup): *3.2 x 15 = KES. 48 **Total cost of curing 1 hide**: 300 + 90 + 18 + 48 = **KES. 456**
Estimated returns	Total cost of curing 1 hide: **KES. 456** Mean price of wet salted hide: KES. 35 x 15 = **KES. 525** Estimated returns: 525 – 456 = **KES. 69 - 369/ hide**
Gender issues and concerns in development, dissemination, adoption and scaling up	1. Flaying/skinning and curing are roles mostly performed by men in slaughterhouses due to the energy-demanding nature of the tasks. 2. Women may have limited access to hide and skin flaying and curing information, knowledge, and training as such services are usually provided by in-house meat inspectors at slaughterhouses that are dominated by men (97 – 100 %). 3. Decision-making on purchasing, processing, and marketing of hides and skins is dominated by men as these steps are equally energy-demanding
Gender related opportunities	• With mechanization women may invest in flaying and hide preservation. • Financial inclusion funds (Hustler fund) provide women and youths with opportunities exist for women and youths to acquire the required credit in vest in hides and skin business. • Employment opportunities for young male youths exist in hide and skin flaying and curing industry.

VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may have less access to hide and skin flaying and curing information, technology, and knowledge. • VMGs may also have limited access to finances to buy the required inputs. • VMGs may have limited access to education, training, and extension services. • Due to their social status VMGs may often be excluded from decision making in development and dissemination activities. • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Financial inclusion funds like the Hustler funds provide VMGs with opportunities to acquire the required credit. • Employment opportunities for the VMGs exist in performing the task.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	When hides and skins had market value community owned livestock cooperatives had very successful business e.g. Sarimo Co-operative in North-Horr and Dukana Co-operative both in Marsabit County.
Application guidelines for users	Waste Management Directorate of Veterinary Services (DVS) (2022). Status of Leather Value Chain in Kenya. 1. Kagunyu A., Matiri F., and Ngari E. (2016). Preserving Hides and Skins in Northern Kenya Using Wet Salting Technology https://www.kalro.org/alris/uploademimi/wet-salting-technology.pdf 2. Mwinyikione M., Magero J., Chamining'wa G.N, and Gnanamani A. (2011). Characterization of Hides and Skins curing process and resultant effluent impact on soil profile at Mariakani, Kenya. In the *Innovative Aspects for Leather Industry.* II International Leather Engineering Congress 2011.
F: Status of TIMP readiness (1-ready for up-scaling; 2-requires validation; 3-requires further research**)**	1- Ready for upscaling
G. Contacts	
Contacts	Institute Director, KALRO Beef Research Institute Tel:0725949798Tel:0740557935
Lead organization and scientists	KALRO Beef Research Institute, Lanet Dr. Tura Isako (Institute Director) Victoria Kimindu (Research Scientist)
Partner organizations	1. DArthur Onyuka, Kenya Industrial Research and Development Institute (KIRDI) Leather Section (Directorate of Veterinary Service)

	2. Kenya Leather Development Council (KLDC) 3. National Environmental Management Authority (NEMA) 4. County Leather Technicians

RGaps

1. Reduced use of sodium chloride in hides and skins preservation
2. Determinants of hides and skins quality across livestock breeds, livestock production systems and categories of slaughter facilities.
3. Utilization of low grade (IV and V) hides and skins.

2.6 Manure Management for Bioenergy

2.6.1 Domestic biogas

2.6.1 TIMP name	**Domestic biogas**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• High cost of energy • Inadequate and unreliable clean sources of energy which leads to greenhouse gas (GHG) emissions
What is it? (TIMP description)	Biogas is a renewable energy source that is safe for the environment. Biogas is produced through anaerobic digestion of organic wastes. Biogas is composed of a mixture of methane and carbon dioxide and trace amounts of nitrogen, hydrogen, and carbon monoxide. Biogas is used for domestic use replacing other biomass fuels (charcoal, firewood) and fossil fuel. It powers combustion engines to produce electricity. Domestic biogas digesters help in mitigating GHG emissions, reduce biomass fuel consumption and since biogas burns without smoke, it reduces apparent indoor air pollution. Bio slurry from anaerobic digesters can be used to improve soil fertility, soil structure and crop productivity and reduce the need for constant use of chemical fertilizers. The technology is carbon neutral, and therefore does not add or remove carbon dioxide from the atmosphere.

	
Justification	LInadequate access to affordable and efficient energy leads to the dominance of biomass in residential energy supply and attendant forest cover depletion. Potentially, therefore, it is a significant and profitable way of mitigating global climate change. While introduced in Kenya during the 1950s, uptake/adoption of the technology has been poor without targeted support
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual households, Leaning institutions (schools and colleges), Farmers, Extension agents, Service providers, Researchers, agri-preneurs
Approaches to be used in dissemination	• Agricultural Innovation Platforms (AIP)Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Affordability of the digesters • A firm and solid “business case” made to entice more users • Availability and accessibility of the maintenance crew

Partners/stakeholders for scaling up and their roles	• Trained biogas technicians—to make available installation expertise • Hivos/Kenya Biogas Programme—has deployed outreach staff across the country to support farmers on the optimization of the technology benefits • Development partners NGOs (IFAD, SCODE, SNV, GTZ)—have had programmes targeted at deploying the technology and therefore build experiences around these programmes • Domestic biogas digester developers (Biogas International, Kentainers, Amiran, Simgas)—provide expertise and technical designs • Academic and Research Institutions—undertaking research and providing technical information for use by various stakeholder groups. • Finance institution such as KWFT, Equity- Financial capital • Regulatory bodies (ERC, KEBS)—develop and provide guidelines to regulate sector
C: Current situation and future scaling up	
Counties where already promoted if any	Nyeri, Nyandarua and Taita Taveta
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Low levels of awareness and/or understanding of system and related opportunities (e.g. climate finance) • Technology incompatibility in the absence of sedentary lifestyles (e.g. pastoral livelihoods) • Challenges in acceptance of plants attached to human waste streams
Suggestions for addressing the challenges	• Accessible demonstrations to help demystify the technology and sensitization about available carbon trading platforms • Direct government support at national and county level with firm policies • Build capacity and knowledge about available and potential substrate sources (e.g. castor seed cake) • Structure service and maintenance to fit into the overall dissemination strategy (e.g. create customer service centers and hold repair campaigns).
Lessons learned in upscaling if any	• The role of research and development in ensuring that the product fits market needs to emphasised • Need for emphasizing not just the gas but also the value for organic fertilizer as an additional benefit for users

	• Involvement of key persons/institutions in the process and incorporating community education and sensitization are key to adoption of the technology • Appropriate structures for maintenance and quality control are key for technology's reputation and future uptake. Third party Quality Control mechanisms to monitor functionality of installed units the ground • Direct innovative financing to households is key for scale up, strong companies and technology Service providers are critical in technologies
Social, environmental, policy and market conditions necessary for development and upscaling	• A large pool of dairy farmers have accepted to intensify livestock production and many are undertaking zero grazing • Production of biogas reduces challenges associated with disposal of manure and other farm waste thus reduce pollution to water bodies • Promotion of renewable energy a policy decision by Ministry of Energy (Energy policy 2004) • The energy act delegates biogas regulation to the county governments • County governments have no policies addressing off grid energy options. Need to have strong policies backed by properly targeted support/incentives structures • Many companies supplying prefabricated systems setting up operations in the country • National Policy on Climate Finance to guide mobilization of climate finance that contributes to low carbon climate-resilient developments
Basic costs of the TIMP	• Estimated installation costs for an 8 m^3 sized plant (in 2023). (*NB: Modified designs potentially 25% cheaper to construct*) • Fixed dome (80,000) • Floating drum (75,000) • Tubular (flexi-biogas) (KES 50,000) • Total cost (Capital cost) KES 205,000 • abor Cost/day (collecting, mixing and loading to the digestor) is KES 39.5Gas produced/day is 1050 liters costing KES 262.5
Estimated returns when using the TIMP	• Estimated returns/day • Amount of gas produced/day is 1050ltrs @ KES 0.25= KES 262.5 by 3 cows • Gross margin= 262.5-39.5= KES 223 • Additionally the indirect effect of reducing use of fuel wood • Reduction of pollution arising from smoke • Reduced GHG emission

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination, adoption and scaling up	• Time spent mainly by women in search for fuel wood is reduced by a large margin. However, water demand to run the plants an added "cost"/time for women and youths • Since Technology is used within the household setup, all are involved with most benefits to women and the girl child as kitchen and farm work is made more efficient • The participation of women as trained technicians and masons in the sector may bridge any existing gender divide • The existence of pro-environmental attitudes which can boost uptake of technology fully understood. • Low levels of awareness and understanding of system and related opportunities among women and youth • The initial investment (installation) costs is high and may be inaccessible to women and youth • Water demand to run the plants is an added "cost"/time for women and youths who have less access to income. • Challenges in acceptance of plants attached to human waste streams among women
Gender related opportunities	• Time spent mainly by women in search for fuel wood and the same may be spent on other economical ventures • The participation of women as trained technicians and masons in the sector may bridge any existing gender divide • A firm and solid "business case" especially for the youth • Women groups can also turn the Biogas technologies into a business opportunity through marketing and engaging in the installation of plants • ffirmative action opportunities exist for women and youths to acquire the required credit Women and children save up to 5 hours each week which they would otherwise spend fetching firewood and thus labor savings are available for other productive tasks as well as leisure.
VMG issues and concerns in development, dissemination adoption and scaling up	• Innovative financing including lease to own over a long period of time to ensure affordable terms in accessing the technology may benefit VMGs • Rebates and other financial instruments to lower the initial cost of acquiring the technology may be beneficial to VMGs • Target VMGs for promotion of biogas technology among members and ensure they are included in scaling • The existence of pro-environmental attitudes among the VMGs is not clear

	• The initial investment (installation) costs are high and may be inaccessible for VMGs • Water demand to run the plants is an added "cost"/time for VMGs who have limited access to income
VMG related opportunities	• Target VMGs for promotion of biogas technology among members and ensure they are included in scaling • VMGs can use slurry as a business opportunity
E: Case studies/profiles of success stories	
Success stories from previous similar projects	1. The Africa Biogas Partnership Program through the Kenya Biogas Programme (KBP) - over 13,200 plants have been installed in 42 counties in Kenya over the period 2009-2017 2. SDCP (IFAD) through Biogas International-the installation of flexi-biogas systems in selected counties
Application guidelines for users	• Kenya National Domestic Biogas User Manual. • KALRO Biogas leaflet
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director, KALRO DRI Naivasha P.O. Box 25 -20117 Naivasha, Kenya
Lead organization and scientists	KALRO, William Ayako, Sambu Saitoti, Stephen Mailu, Peterson Njeru, MacDonald Githinji, Tabeel Nandokha
Partner organizations	Pwani University, Moi University: Centre of Excellence in Phytochemicals, Textile & Renewable Energy (PTRE), Kenya Biogas Programme (Hivos/SNV), SCODE, Biogas International

2.6.2 Bio degradation of manure using BSF

2.6.2 TIMP name	**Bio degradation of manure using BSF**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Challenges in disposal of cow dung due to its bulkiness • NotInability to degrade oragnic waste to release nutrients for soil improvement. • Greenhouse gas (GHG) emissions
What is it? (TIMP description)	Biodegradation of organic waste like manure occurs through anaerobic biodegradation of anaerobic biodegradation. It takes a long time before full biodegradation can be achieved. The process can however be hastened through the use of black soldier

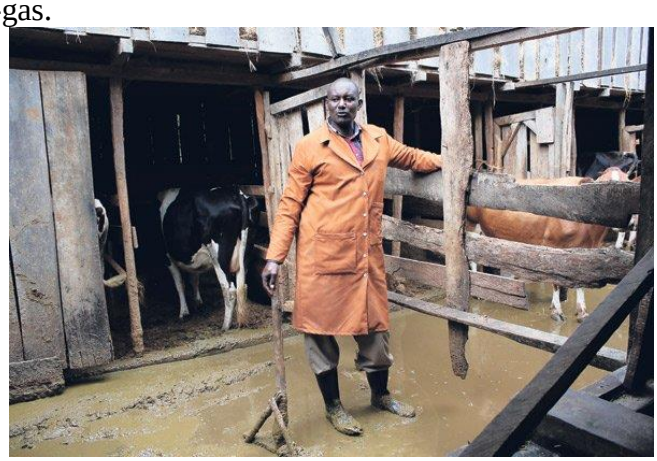
	flies (BSF). Black soldier fly (*Hermetia illucens*), are beneficial insects which are not harmful to both environment and human health. They dwell in both tropical and sub-tropical regions. They belong to dipteran family Stratiomyida which are organic waste decomposers. They are highly prolific thus very efficient in bio degradation of organic waste.
	 BSF larvae Source: KALRO  Frass Source: KALRO
Justification	BSF being an organic bio degrader and very prolific in nature, they have a potential of bio-degrading cow dung into frass (organic fertilizer) thereby reducing the bulkiness of the dung. The frass (organic fertilizer) can be applied to the soil to improve its fertility. Through bio degradation, the GHG emissions are reduced.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Individual farming households, medium and large-scale dairy farmer, dairy farmer groups, service providers, agri-preneurs and extension agents
Approaches to be used in dissemination	• Public and private agricultural extension serviceFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days

	• Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Appropriate training • and eproperly kitted/quipped demonstration training sites
Partners/stakeholders for scaling up and their roles	• ECounty governments – to train farmers on BSF and monitor implementation • KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation • ICIPE – breeder, provision of new BSF colonies. • Regulatory body KEBS & NEMA - Develop and provide guidelines to regulate the sector
C: Current situation and future scaling up	
Counties where already promoted if any	Bomet, Nyandarua, Nyeri, Kisii, Laikipia, Embu, Siaya, Mombasa, Baringo and Wajir
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	Inadequate trainers and training sites
Suggestions for addressing the challenges	Capacity building of trainers and equipped demo training sites
Lessons learned in upscaling if any	Organic waste is fully bio degraded by BSF within a short period of time of as less as 3-5 days
Social, environmental, policy and market conditions necessary for development and upscaling	• A large pool of dairy farmers have intensified production and are already undertaking zero grazing • Manure biodegradation is necessary to minimize environment contamination • County governments have no policies addressing use of BSF in bio degrading manure. Need to have strong policies backed by properly targeted support/incentives structures • National Policy on Climate Finance to guide mobilization of climate finance that contributes to low carbon climate- resilient developments • There will be ready market for BSF larvae for use in waste management
Basic costs of the TIMP	• Estimate cost of installing a standard BSF unit (capital cost) (3m by 3m by 7m) is KES. 110,000.00 • Cost of producing 30kg of frass is KES 316 or KES 10.5/day (labor charges for harvesting, sieving,

	cleaning, sun drying and packaging KES 316 person/day to prepare 30kg of frass/day)
Estimated returns when using the TIMP	Market price of selling 30kg of frass is KES 900/day Estimate returns/day = sale price less cost of production (KES 900-316=583.2)
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination, adoption and scaling up	• The technology is labour intensive and may not be adopted by women who are already overburdened with other activities such as domestic, care and other productive activities • Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services. • Women may have less access to resources such as credit, implements and inputs required for the implementation management practice • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit to invest in waste mangement ventures • Employment opportunities for youths exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have less access to agricultural information, technology and knowledge. • VMGs may also have limited access to finances inputs required for the implementation management practice. • VMGs may have limited access to education, training and extension services. • Due to their social status VMGs may often be excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit to invest in waste management ventures • Employment opportunities for youths exist in performing the task
E: Case studies/profiles of success stories	
Success stories from previous similar projects	-None
Application guidelines for users	The BSF protocol manual/booklet available at KALRO Ol Joro Orok 1. Rearing, multiplication and bulking of BSF guide available at KALRO Ol Joro Orok

F: Status of TIMP readiness (1. Ready for upscaling 2. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Director, KALRO DRC Ol Joro Orok P.O. Box 200 -20302 OL JORO OROK, Kenya Email; kalrooljk@gmail.com Mobile: +254 710 854 357
Lead organization and scientists	Naftali Kanegeni, Wiliam Ayako and Sambu Saitoti
Partner organizations	Egerton University, Kisii University, ICIPE

2.6.3 Utilization of bio-slurry manure for soil nutrient management

2.6.3 TIMP (name)	**Utilization of bio-slurry manure for soil nutrient management**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• High-cost of inorganic fertilizer • Erratic availability of inorganic fertilizer • Excessive use of inorganic fertilizer is known to contribute to GHG emission which has negative repercussions on the environment.
What is it? (TIMP description)	Bio-slurry is semi-solid waste produced mainly by dairy cattle housed in a zero grazing housing system. It is composed of dung, urine and waste water used for cleaning the stable. Slurry is partially degraded by bacteria in a biogas digester to produce bio-gas.  Bio-slurry Source: KALRO
Justification	The use of inorganic fertilizers to mitigate soil fertility decline in smallholder dairy farms mainly due to high costs, low producer prices (of both food crops and milk) and erratic availability. This has had a negative impact on available quantity and quality of Napier grass as

	livestock feed and hence hindered smallholder dairy production. Excessive use of inorganic fertilizer is known to contribute to GHG emission which has negative repercussions on the environment.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy producers, Producer organizations, agri-preneurs and common interest groups
Approaches to be used in dissemination	• Public and private agricultural extension servicesFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Appropriate training and equipped demo training sites
Partners/stakeholders for scaling up, their roles and stage of involvement	• Ministry of Agriculture and Livestock Development (MoALD)-Policy formulation • County governemts -extension services • CIGs (Common Interest Groups)- Implementers • KALRO-development, validation of TIMPs and capacity development • co-ordination roles and back stopping at grass root levels ILRI-development of TIMPs • technical backstopping NNGOs (Non-governmental organizations)- promotion, micro financing
C: Current situation and future scaling up	
Counties already promoted if any	Kilifi, Kiambu, Kajiado, West Pokot, Narok, Baringo, Laikipia, Machakos, Nyeri, Tharaka Nithi, Lamu, Taita Taveta, Busia, Siaya, Nyandarua, Bomet, Kericho.
Counties where TIMP will be up-scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	Inadequate trainers and training sites
Suggestions for addressing the challenges	Capacity building of trainers and equipped demo training sites
Lessons learned in up-scaling if any	Bio slurry manure is relatively cheap and available, and has the capacity to improve soil fertility
Social, environmental, policy and market	• A large pool of dairy farmers have intensified and are willingly undertaking zero grazing

conditions necessary for development and upscaling	• Management of bio-slurry helps in ensuring hyiegenic conditions on the farm • County governments have no policies addressing use of bio-slurry manure. Need to have strong policies backed by properly targeted support/incentives structures • National Policy on Climate Finance to guide mobilization of climate finance that contributes to low carbon climate- resilient developments • Less contaminated milk produced for the market
Basic costs	Slurry produced/day/cow is 10kg Labor cost (collecting, transportation and application) of producing 10kg is KES 13.2
Estimated returns	Market price of selling 10kg of slurry is KES 500 Gross margins= 500-13.2= KES 486.8
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination adoption and scaling up	It is labor intensive in terms of collection, handling and application (often by broadcasting) hence is disadvantageous to women and youth
Gender related opportunities	• Bio-slurry may improve food and nutrition security and thus beneficial for women and youths • Composting resources are locally available for farm households who keep livestock, hence opportunities available for both men and women
VMG issues and concerns in development, dissemination, adoption and scaling up	• Use of bio-slurry is labor intensive in terms of collection, handling and application hence may disadvantage VMGs. • Bio-slurry degradation requires heavy investment i.e. owning dairy cows, cattle shed and biogas digesters which may disdvantage VMGs
VMG related opportunities	B The VMGs may take advantage of bio-slurry to grow vegetables and other nutritious food
E: Case studies/profiles of success stories	
Success stories	-
F: Status of TIMP Readiness (1. Ready for up scaling; 2. Requires further research)	Ready for upscaling
Application guidelines for users	1. Dairy Value chain ToT Manual available on the KALRO web site the KALRO web siteMaterials that cannot be used for composts include,
G: Contacts	
Contacts	Institute Director, KALRO DRI Naivasha P.O. Box 25 -20117 Naivasha, Kenya
Lead organization and scientists	KALRO, William Ayako, Sambu Saitoti, Stephen Mailu, Peterson Njeru, MacDonald Githinji, Tabeel Nandokha
Partner organizations	Kenya Institute of Organic Farming, Pwani University, Moi University: Centre of Excellence in Phytochemicals, Textile & Renewable Energy

	(PTRE), Kenya Biogas Programme (Hivos/SNV), SCODE, Biogas International

Gaps

Need for standards for prefabricated systems and standards for use of organic fertilizer from the bio-digesters

2.7 Dairy Cattle Health Management

2.7.1 Theileria parva Marikebuni East Coast Fever (ECF) vaccine

2.7.1 TIMP name	***Theileria parva* Marikebuni East Coast Fever (ECF) vaccine**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Reduced productivity due to high mortality rates associated with East coast fever (ECF) in dairy and beef cattle reduces productivity • High cost of treatment of clinical cases
What is it? (TIMP description)	This is a vaccine that confers life-long protection against ECF. It is formulated from live a cocktail of *Theileria parva* Marikebuni parasites. The vaccine is packed in 20 and 40 doses straw and stored in liquid nitrogen at -196^{o}C.The vaccine is reconstituted in diluent and adminitered to cattle simultaneously with 30% oxytetracycline antibiotic to prevent parasites from causing clinical disease. The vaccine is administered by trained personnel. After animals are immunized with this vaccine, tick control is relaxed with spraying or dipping done after 2-3 weeks which saves dairy farmers money.  ECF vaccine vials in a liquid nitrogen tank Source: KALRO

Justification	East Coast Fever (ECF), disease is transmitted by ticks and causes high mortality and production losses in cattle. In addition, control of the tick vector through frequent acaricide application and high cost of treatment of ECF infected animals increases cost of veterinary care. The ECF vaccine confers life-long immunity in cattle thereby reducing ECF incidence and cost of acaricide application. Therefore, the vaccine improves the productivity of cattle, saves smallholder dairy farmers money spent on treating clinical cases and decreases acaricide-associated pollution of the environment as well as resistance to acaricides and
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy and beef farmers, Extension agents, Service providers, agri-preneurs and Researchers
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services • Hands
Critical/essential factors for successful promotion	• Availability of trained vaccinators • Sensitization of the cattle keeper about the advantages of the vaccine in controlling ECF • Production and supply of quality vaccine • GA traceability system to differentiate vaccinated from unvaccinated cattle to avoid repeated vaccinations

Partners/stakeholders for scaling up and their roles	• KALRO-Vaccine production and training of vaccinators • Director of Veterinary Services (DVS)- Policy and regulation • VeterinaryMedicines Directorate (VMD) – • Registration of the vaccine • County Governments – Extension services and vaccine administration • Private veterinary professionals – Vaccine administration • Global Alliance for Livestock Vaccines and Medicine (GALVmed)- Vaccine Promotion • ILRI – Research on the different forms of ECF vaccine
C: Current situation and future scaling up	
Counties where already promoted if any	Bomet, Kericho, Kakamega, Nyeri, Kisumu, Nyandarua, Narok, Trans Nzoia, Nandi, Uasin Gishu
Counties where TIMP will be up scaled	KKilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi
Challenges in dissemination	• Demand for the vaccine outstrips supply • Fewer number of trained vaccinators • High costs associated with overreliance on liquid nitrogen for vaccine storage • Low shelf life of vaccine at room temperature • Poor vaccine distribution network • Vaccine packaged in doses of 40 and not suitable for smallholder farmers with 3-5 animals
Recommendations for addressing the challenges	• Produce more vaccine doses to meet the demand. • Train more veterinary professionals on vaccine administration-Lobby for incorporation of ECF immunization in animal health training curriculum • Lobby for funds to install liquid nitrogen plants at the KALRO VSRI Muguga • Establish strategic regional vaccine distribution networks in other KALRO livestock institutes/centres • Sensitize cattle farmers on the availability of the vaccine through participatory approaches. • Produce and package vaccine in small dose packs of probably 5 to 10 doses. • Production of promotional materials, use of media in popularizing the vaccine

Lessons learned in up scaling if any	• There are better returns when vaccine is used on young animals since they will stay longer on the farm • Screening of animals to ensure they are free from *Theileria parva* Marikebuni parasites is necessary before immunization to minimize risk of causing clinical disease • EA functional traceability system is necessary to avoid vaccinating animals that have recovered from infection since they already have life-long immunity • Even with ECF vaccination, relaxed tick control is necessary for the control of other tickborne diseases such as anaplasmosis and babesiosis • Involvement of Counties and NGOs in training of vaccinators improves the uptake of ECF vaccine • The active involvement of the Kenya Veterinary Board in reviewing and approving content for vaccinator training of veterinary professionals enhances professionalizes the conduct of ECF vaccinators
Social, environmental, policy and market conditions necessary for development and up scaling	• There is need to enhance acceptance of ECF vaccine by dairy cattle keepers in the control of ECF • There is need for policy to regulate acaricide use following ECF immunization to reduce acaricide overuse and environmental contamination • There is need for policy guidelines and regulation on the use of the vaccine to avoid introducing the *Theileria parva* in areas which are free from the parasite • Need for regulation of vaccine pricing to reduce farmer exploitation
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 600 to 800 to cover for the cost of vaccinating one animal (cost of vaccine, antibiotic and vaccinator labour)
Estimated returns	• The use of ECF vaccine saves approximately 80%, of cattle from dying from the disease • Farmers are able to save 50% on acaricide costs as spraying/dipping frquency is reduced from weekly to once every two weeks • (Immunization reduces losses of KES 9975 per cow per year)

Gender issues and concerns in development, dissemination, adoption and scaling up	• ECF vaccine is administered through injections thus requiring that animals are properly restrained which may not be favourable for women. • Women may have limited ability to influence decision- making in their household around vaccination and animal health • Vaccinators go through 3 to 4 days training at the VSRI Muguga which may limit the number of women participants • Women may have poorer access to markets and play a limited role in the commercialization of livestock • Women and youth may have limited access to finances necessary to acquire the vaccine • Involvement of women and youth in vaccine distribution may be limited by its requirement for cold chain
Gender related opportunities	• Trained vaccinators are likely to earn an extra income by actively participating in ECF vaccination drives • Knowledgeable women and youth can enter in to the distribution chain for income generation • Organize livestock farmers into groups so that they can vaccinate their animals at the same time • ECF vaccination will enhance livestock production for better food, nutrition and incomes for households
VMG issues and concerns in development, dissemination, adoption and scaling up	• Limited knowledge of vaccine among VMGs who may have low access to agricultural information and extension services • VMGs may have limited access to credit to acquire the vaccine • Involvement of VMGs in vaccine distribution may be limited by the its cold chain requirement
VMG related opportunities	• VMGs can form common interest groups for collective access of the technology and enter in to the distribution chain for income generation • ECF vaccination will enhance livestock production for better incomes and food and nutrition security for VMGs
E: Case studies/profiles of success stories	

Success stories from previous similar projects	1. Lanet Beef Research Institute in Nakuru County has significantly reduced mortalities from 50% to 10% in their boran herd after adopting the use of ECF vaccine to control ECF. 2. The success of the Kenya Dairy Farmers Federation (KDFF), one of the distributors of ECF vaccine has vaccinated >25,000 dairy cattle against ECF over the last 5 years in Uasin Gishu, Nandi and Nakuru Counties. Increased demand for ECF training for vaccinators at the VSRI Muguga with about 454 (15 from Uganda, 8 from Rwanda and 431 from Kenya) veterinary professionals already trained to deliver ECF vaccine between 2011 and 2022
Application guidelines for users	1. Ndung'u, S.G., Wesonga, F.D., Olum, M and Maichomo, M (2016). Training manual for veterinary staff immunization against ECF. 64 pages. Available at KALRO VSRI Muguga
	2. Brochure on tick control after ECF immunization. Available at KALRO Muguga 3. Poster on important tick-borne diseases in Kenya Available at KALRO VSRI Muguga Brochure on East Coast Fever. Available at KALRO VSRI Muguga -Brochure on steps in ECF immunization and post-immunization monitoring. Available at KALRO VSRI Muguga
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	TInstitute Director KALRO VSRI Muguga North P.O. Box 32 -00902 Kikuyu, Kenya
Lead organization and scientists	KALRO VSRI Muguga, James Wanjohi, Moses Olum
Partner organizations	GALVmed, KDFF, SIDAI, VetAID, County Governments, DVS and KEVEVAPI

RGaps

1. Evaluate the effects of relaxed acaricide recommendation on sustainable control of other tick-borne diseases e.g. Anaplasmosis, Babesiosis and Cowdriosis.
2. Develop and promote small dose packs appropriate for use by smallholder dairy farmers.
3. Validate and make recommendations for use of Theileria parva marikebuni ECF vaccine in the pastoral production systems.

4. Produce a vaccine batch in response to the increased demand for this product.
5. Assess development, adoption and scaling up of the technology with gender and VMGs in consideration
6. Assess development, adoption and scaling up of the technology with gender and VMGs in consideration

2.7.2 Contagious Bovine Pleuro-pneumonia (CBBP) DIVA Vaccine

TIMP name	**Contagious Bovine Pleuro-pneumonia (CBBP) DIVA Vaccine**
Category (i.e. technology, innovation or management	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	● Low productivity from beef cattle due to high incidence of CBPP ● Lack of traceability to differentiate vaccinated from non-vaccinated cattle (DIVA) which has the restricted use of the current vaccine ● Trade embargoes due to the transboundary nature of CBPP because.
What is it? (TIMP description)	The CBPP DIVA vaccine is a modification of the current CBPP T1/44 live attenuated vaccine formulated from *Mycoplasma species* from a Tanzanian outbreak strain T1. The T1/44 vaccine which is repeatedly grown on culture media 44 times to ensure the *Mycoplasma* remains is less infective but is immunogenic is then tagged with a protein marker that makes it possible to differentiate antibodies from cattle vaccinated with the DIVA vaccine from those from cattle not infected but naturally infected. Antibodies from vaccinated cattle will have a tag which is easily detectable.
Justification	Contagious Bovine Pleuropneumonia (CBPP) is a transboundary disease that lowers cattle production in Kenya. The disease, is transboundary impacts negatively on international trade in livestock and livestock products. As such detection of the disease in an area attracts trade barriers and restrictions. Moreover, the use of T1/44 CBPP vaccine is restricted by regulatory bodies because of its weak traceability it lacks DIVA properties to differentiate vaccinated from infected unvaccinated cattle. Modifying the current CBPP vaccine by incorporating a protein tag confers DIVA properties making it possible to differentiate cattle from the infected unvaccinated ones. The use of DIVA CBPP vaccine enhances productivty of cattle as well as trade in livestock and livestock products.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	airy farmers, Governments, , of Agriculture and Livestock Development (MoALD), Livestock Extension providers and Agri-preneurs
Approaches to be used in dissemination	• AgriculturalFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Functional working relations/MOU with KEVEVAPI the veterinary vaccines commercial producer • Incorporation of animal health product regulators (VMD, DVS, NACOSTI, the Kenya Veterinary Board (KVB) into the vaccine development and commercialization process • Registration and patenting of the DIVA vaccine • Functional and effective vaccine distribution channels
Partners/stakeholders for scaling up and their roles	• Extension service providers (Public and private) - to offer advice and collect information on the uptake of the vaccine. They will also ensure proper use of the vaccine • County Governments - to promote and create awareness on the advantages of the vaccine • NACOSTI-Regulate research • DVS - Policy, regulation on use of the vaccine and animal disease control • andVMD - Registration of vaccines and sera • Pastoralists, farmers and farmer groups-users of the vaccine (provide their livestock for vaccination) • KALRO-development and validation of the vaccine, train trainers of trainers (ToT and provide technical backstopping during dissemination of the vaccine • KEVEVAPI-t o produce the vaccine and ensure quality assurance and distribution • Vaccine stockists- to ensure distribution and availability of the vaccine at the point of use.
C: Current situation and future scaling up	

Counties where already promoted if any	None
Counties where TIMP will be up scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Inadequate knowledge on the use of the vaccine • Inadequate vaccine distribution network • Inadequate vaccine access for individual farmers/pastoralists due to centralized CBPP vaccine use control by DVS
Recommendations for addressing the challenges	• Creating awareness and promotion of the vaccine • Capacity building of extension workers on the use of the vaccine • Strengthen Public private partnerships for sustainable distribution of the vaccine • Lobby for eased DVS control on CBPP vaccine to allow participation of private partners in vaccine delivery • Encourage formation of community pastoral/farmer groups to increase vaccine accessibility
Lessons learned in up scaling if any	• Working with partners with a competitive advantage ensures successful development and commercialization of the vaccine • Demonstration of benefits of vaccination will enhance farmer willingness to adopt the vaccine
Social, environmental, policy and market conditions necessary for development and up scaling	• Livestock keepers will willingly adopt the use of CBPP DIVA vaccine in control of CBPP • The use of the DIVA CBPP has limited effect on the environment • Need for policy to guide the incorporation of DIVA vaccine in CBPP control in Kenya and the region • Need to register the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region • There is need to lobby DVS to relax the supervision of vaccinations to allow involvement of private service providers to expand uptake and market
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Approximately KES 100 per animal per year (every cattle in CBPP hotspots receives two vaccinations per year)

Estimated returns	• Vaccination reduces mortalities experienced dueing CBPP outreaks from 50% to about 10% ensuring there is 80% survival rates from the avoided CBPP deaths • ApproximatelyCost saving on treatment of sick cattle • ,Increase in livestock trade due to a reduction in interruptive market activities occasioned by quarantines and livestock movements
Gender issues and concerns in development, dissemination, adoption and scaling up	• Limitations in information access due to gender inequalities in education • Lower participation of women in vaccine dissemination activities due to cultural barriers • Gender inequalities in resource ownership and decision making may limit access of women and youth to the vaccine • Restraining of animals during vaccination may present a challenge to women • Cultural practices that limit participation of certain gender categories in various aspects beef production including vaccination and distribution of vaccines • Limited time and mobility for women to attend extension activities when there are conflicting roles
Gender related opportunities	• The use of vaccine will increase result in improved survival rate and productivity of cattle thus providing households with enhanced food and nutrition security • Involvement of trained youth in vaccination for them to earn an extra income by actively participating in vaccination drives • Knowledgeable women and youth can invest and participate in vaccine distribution chain for income generation
VMG issues and concerns in development, dissemination, adoption and scaling up	• Due to their social status VMGs may often be excluded from decision making during dissemination of technologies • VMGs may face barriers in accessing resources such as credit and information • VMGs may often be excluded from accessing and benefitting from technologies • Restraining of animals during vaccination may present a challenge to VMGs • The technology is labour intensive and very technical may require VMGs to hire service providers

VMG related opportunities	• VMGs can form common interest groups (CIGs) for collective access of the technology and enter in to the distribution chain for income generation • Vaccine Adoption will lead to increased animals' productivity hence increased incomes and improved food and nutrition security
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	None
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, Biotechnology Research Institute, KALRO P.O. Box 362-00902 Kikuyu email: director.biori@kalro.org
Lead organization and scientists	KALRO Biotechnology Research Institute, Martin Mwirigi
Partner organizations	DVS, KEVEVAPI, VMD, County Governments

RGaps

1. Determine the cost-benefit of using the test in the control of vaccine
2. Assess development, adoption and scaling up of the technology with gender and VMGs in consideration
3. Develop guidelines for successful use of the vaccine

2.7.3 Recombinant HC58 DNA Vaccine

4.3. TIMP name	**Recombinant HC58 DNA Vaccine**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	

Problem to be addressed	Productivity losses from the highly pathogenic stomach worm *Haemonchus contortus* in exotic goat. producingHigh incidences of anthelmintic resistance due to misuse of anthelmintics in the control of *H. contortus*  *Haemonchus contortus* on abomasum surface Source; © The Royal (Dick) School of Veterinary Studies The University of Edinburgh, Easter Bush Veterinary Centre, ROSLIN, Midlothian, Scotland, EH25 9RG
What is it? (TIMP description)	This is a molecular (Deoxyribose Nucleic Acid, DNA) based vaccine against *Hemonchus contortus* worms in sheep and goats. The vaccine is based on the immune-inducing cysteine protease of *H. contortus* that reduce worm burden by 47%. The vaccine is administered through a deep intra muscular injection. The first vaccine dose is followed with a booster injection after 10 days post-administration.
Justification	*Haemonchus contortus* is a highly pathogenic parasite affecting sheep, goats and cattle and causes major economic losses to due to mortality of affected animals. Control costs of *H. contortus* and other nematode parasites are estimated to be over KES 600 billion (US$5,000million) annually. Haemonchosis control is predominantly done using chemical anthelmintics and grazing management. The excessive and uncontrolled use of anthelmintic drugs has resulted in the emergence of helminth resistant strains of the parasite, toxic residues in the human food chain and environmental pollution. Controlling haemonchosis through vaccination is the ultimate, effective and sustainable strategy. The recombinant HC58 DNA vaccine has been developed but requires further field testing and up-scaling for adoption.
B: Assessment of dissemination and scaling up/out approaches	
Users of the TIMP	airy goat keepers, researchers, African Veterinary Vaccine Centre of African Union (AU- PANVAC), FAO. Agri-preneurs

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services • Print
Critical/essential factors for successful promotion	• Stakeholder participation especially county livestock and veterinary staff • Friendly regulations and guidelines for the use of vaccine • supply of the vaccine • Affordable vaccine
Partners/stakeholders for scaling up and their roles	• Egerton University – Technical backstopping, training of trainers, registration of the vaccine, • KALRO – Development and validation of vaccine • KEVEVAPI – Production and distribution, • DVS – Policy and regulation, • VMD – Registration and certification • GalVMED-Promotion of the vaccine • Farmers- End users • County Governments – Extension and vaccine distribution • Non-Governmental Organizations (NGOs) – Promotion
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be up-scaled	None
Challenges in dissemination	• Stringent registration steps of the vaccine since genetically modified organisms (GMOs) are highly regulated • Inadequate technical capacity to develop and produce the vaccine • Inadequate capacity at KEVEVAPI to produce the vaccine • Low acceptance of a vaccine against worms • Inadequate information and guidelines on the use of the

Suggestions for addressing the challenges	• Involve regulatory authories like the National Biosafety authorityin the development of the vaccine for early buy in • Build the capacity of technicians and scientists involved in the development of the vaccine • Need to promote acceptance of the vaccine • Need for policy to guide the incorporation of Recombinant HC58 DNA Vaccine in helminth control in sheep and goats in Kenya • Need to register the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region
Lessons learned in up-scaling if any	None
Social, environmental, policy and market conditions necessary for the development and upscaling	• Need to promote acceptance of the vaccine • The HC58 vaccine has no negative effect on the environment • Need for policy to guide the incorporation of Recombinant HC58 DNA Vaccine in helminth control in sheep and goats in Kenya • Need to fast track the development and validation of the vaccine for it to be taken through the registration process by the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region before it is commercialized
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	N-
Estimated returns	C-
Gender issues and concerns in development, dissemination, adoption and scaling up	• Recombinant HC58 DNA vaccine is administered through injections thus requiring that animals are properly restrained which may not be favourable for women. • Cultural practices that limit participation of certain gender categories in various aspects livestock production including vaccination • Limited time and mobility for women to attend extension activities when there are conflicting roles • Women may have limited ability to influence decision-making in their household around vaccination and animal health

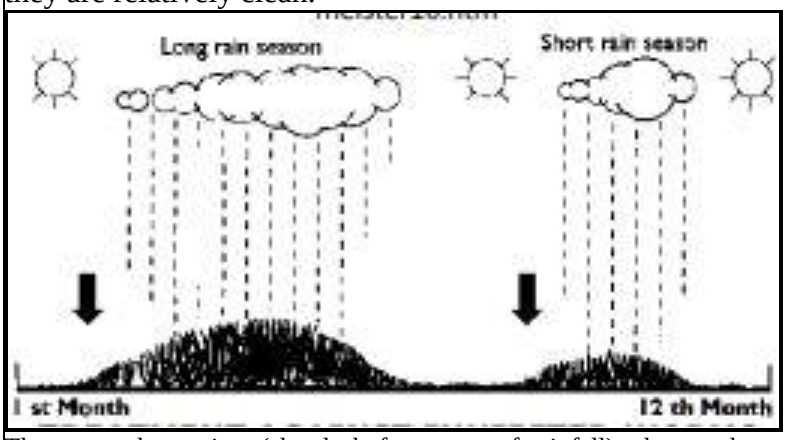
Gender related opportunities	Trained vaccinators are likely to earn an extra income by actively participating in ECF vaccination drives • Knowledgeable women and youth can enter in to the distribution chain for income generation • The use of vaccine will increase income and provide household nutrition
VMG issues and concerns in development, dissemination, adoption and scaling up	• Due to their social status VMGs may often be excluded from decision making during dissemination of technologies • VMGs face barriers in accessing information • VMGs have limited access to credit to acquire the vaccine • The technology is labour intensive and very technical may
VMG related opportunities	Create incentives for VMG owned vaccine distribution networks
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None
Application guidelines for users	Not yet determined
F: Status of TIMP readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research)	Requires further research
G: Contacts	
Contacts	Egerton University P.O. Box 536 - 20115, Egerton-Njoro, KENYA e
Lead organization and scientists	Egerton University, Charles Muleke; KALRO Headquarters, Erick Mungube
Partner organizations	KEVEVAPI, DVS, VMD, AU-PANVAC, FAO

Research Gaps

1. Determine the cost-benefit of using the test in the control of CBPP
2. Develop guidelines for successful use of the test

2.7.4 Integrated Helminth Control

2.7.4 TIMP name	**Integrated Helminth Control**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem to be addressed	• Low productivity in farm animals including cattle, and goats due to high helminth burden • High cost of deworming due to lack of a guideline on sustainably helminth control. • Rising incidence of anthelmintic resistance
What is it? (TIMP description)	TIntegrated helminth control is a strategy where worm control is based on a combination of methods including use of dewormers, pasture management and husbandry practices. Animals are dewormed in times when the risk of helminth infection is high. Deworming is timed to happen shortly before onset of the rains to minimize contamination of pasture with infective helminth eggs which exposes livestock to the risk of re-infection during grazing. Repeat worming should be done at the end of the rainy season so that animals enter the dry season when they are relatively clean.  The arrow shows time (shortly before onset of rainfall) when to deworm livestock Source: KALRO/DFID
Justification	igh prevalence of worms reduces productivity in the red meat and dairy value chains. The irrational use of dewormers results in high resistant worms which increases the burden of controlling worms. The use of the integrated helminth control strategy ensures deworming happens when justifiable thus saves farmers money. It also reduces the speed with which helminths develop resistance to commonly used anthelmintics.Routine deworming as often practiced may result in unnecessary
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy, animal farmers, Extension Service Providers, Researchers, agr-preneurs, Agrovets

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Use of correct dose, dosing technique and timing. • Policy guideline to regulate use of anthelmintics • Create awareness on integrated helminth control • Cultivate good working relationship and incorporation of DVS and County Governments in development and promotion of the strategies
Partners/stakeholders for scaling up and their roles	• KALRO- Research on new and alternative anthelmintic drugs, monitor resistance trends and develop resistance best-bet management options • County Governments - Extension services- dissemination of information and ensure proper use of Management practice • Private veterinarians – Clinical services • Pharmaceutical companies - Supply of anthelmintic drugs • VMD-Registration of new anthelmintic drugs before they go to the market • DVS – Regulate use of anthelmintic drugs • Livestock keepers- end users of the management practice and dissemination of information on the management practice
C: Current situation and future scaling up	
Counties where already promoted if any	Nyeri and Kericho
Counties where TIMP will be up scale	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia

Challenges in dissemination	• Inadequate awareness about existence of the integrated helminth control strategy • Proliferation of anthelmintic drug brands in the market some of which are counterfeits • Liberalized market for anthelmintic drugs which is hard to regulate • Under dosing since worming is based on animal live weights • Wrong timing for deworming.
Recommendations for addressing the challenges	• Create awareness about how the integrated helminth control strategy works • Enforce regulations on registration of drugs to enhance quality • Capacity build farmers and technicians on correct doses, • Develop farmer-friendly guidelines on proper dosing and application of dewormers • Avail simple and easy to use weighing techniques to encourage dosing based on live weight • Ensure worming is done based on season and risk of helminth infection
Lessons learned in up scaling if any	• Deworming can be timed to only be done when needed • Farmers if trained can be able to estimate the weight of their animals as a guide to giving correct anthelmintic drug dosages • Application of the management practice saves unnecessary costs
Social, environmental, policy and market conditions necessary for development and upscaling	• Willingness to adopt this practice for control or worms • The practice has limited effect on the environment • Need for policy guidelines on anthelmintic use (in view of Animal disease Act (CAP 364) as enforced by DVS) • Need for regulation on anthelmintic quality to reduce counterfeited anthelmintics in the market
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 40-60/dose of anthelmintic
Estimated returns	The adoption and use of this strategy where you deworm when risk is high will save up to 30% of deworming costs incurred when deworming is done after once after 3 months

Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have challenges handling animals during deworming • Women may have limited access to information and knowledge on the use of integrated helminth control. • Women may have limited access to education, training and extension services. • Cultural practices may limit women from performing the task • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities for youth males exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have limited access to education, training and extension services. • Due to their social status VMGs may often be excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit • Employment opportunities for youth males exist in performing the task
E: Case studies/profiles of success stories	
Success stories from previous similar projects	1. The integrated helminth control was promoted extensively in many agro-ecological zones of Kenya by KARI-DFID (1994-2000). 2. The integrated helminth control strategy successfully used on dorper sheep belonging to the community sheep breeding groups in Laikipia and Kajiado Counties in 2021-2022 during implementation of KCSAP
Application guidelines for users	KARI-DFID (1999)-Integrated helminth control (Technical Note No. 2) and is available at KALRO VSRI Muguga
F: Status of TIMP readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Institute Director KALRO – VSRI, Muguga North P.O. Box 32 - 00902 Kikuyu, Kenya

Lead organization and scientists	KALRO VSRI - Muguga Nginyi J.; KALRO HQts Mungube E.O.
Partner organizations	DVS, Pharmaceuticticals, County Governments, VMD

RGaps

1. Update the strategic helminth guidelines to make them responsive to changes in climatic conditions and land use patterns which have an impact on helminth prevalence.
2. Develop and validate integrated helminth control packages to address rising incidences of anthelmintic resistance and residues in milk and meat.
3. Develop helminth risk maps and assess anthelmintic resistance patterns
4. Assess development, adoption and scaling up of the technology with gender and VMGs in consideration

2.7.5 Push-Pull for tsetse fly control

TIMP name	**Push-Pull for tsetse fly control**
Category (i.e. technology, innovation or management	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Reduced productivity of dairy cattle due to high incidence of Nagana • High cost of controlling nagana in dairy cattle • Ineffective treatment due to increased trypanocidal drug resistance
What is it? (TIMP description)	TPush-pull is a technology that uses attractants and repellant chemicals blends to repel or attract tsetse flies away from or to cattle. Repellants keep tsetse flies away from cattle thus reducing infection rates while attractants pull tsetse flies to insecticide treated cattle ensuring they come into lethal doses of insecticides that kill those that attempt to feed on cattle thus reducing transmission of trypanosomes and reducing the risk of spreading nagana.
Justification	igh incidence of Nagana reduces cattle productivity in tsetse infested areas. Over-reliance on and misuse of trypanocides resulted in trypanocidal drug resistance which increase nagan control burden. The use of push-pull enables farmers to keep productive cattle in high tsetse infested areas as risk of transmission of nagana is significantly reduced. This enbales such cattle to remain productive with little treatment of clinical cases. Push-pull will contribute to building the resilience of the farmers by ensuring trypano-susceptible cattle breeds can survive, reproduce and produce milk and calves in high tsetse challenge areas even with no trypanocide treatment.
B: Assessment of dissemination and scaling up/out approaches	

Users of TIMP	Dairy cattle and dairy goat farmers, Extension service providers, Researchers, NGOs, agri-preneurs and CBOs, Agrovets
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services • Field days, on-farm demonstrations, ASKs shows, exhibitions and farmer outreach activities
Critical/essential factors for successful promotion	• Availability of effective repellants and attractants • Training on how to use repellants and attractants on cattle • Extensively promote the use of push-pull in controlling nagana • Ensure full involvement of the pastoralists and stakeholders in the Camel milk and meat value chain • To avoid counterfeiting, encourage the registration by VMD of all chemicals used as repellants and attractants • Involve DVS for enforcing the regulated use of the repellants and attractants
Partners/stakeholders for scaling up	• Kenya Tsetse and Trypanosmiasis Eradication Council (KenTTEC) - Surveillance of tsetse fly and nagana • KALRO – Development and validation of novel attractants and repellants for the effective control of nagana • Universities - Research on tsetse and nagana control • DVS – Policy regulations on tsetse and nagana control • Bio-innovate- Funding agency • County Governments - Extension services • CLivestock keepers-end users of the technology and disseminators of information on its use
C: Current situation and future scaling up	
Counties where already promoted if any	Kwale

Counties where TIMP will be up scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• The repellants and attractants not packaged in form for direct use by farmers • Production of repellants and attractants is still at pre-industrial level • Low awareness levels on existence and use of the push-pull technology
Suggestions for addressing the challenges	• Package repellants in a form that can easily be used by farmers • Fast track patenting, registration and commercialization of repellants and attractants • Sensitize farmers and other stakeholders on the availability of repellants and attractants for controlling tsetse flies
Lessons learned in up scaling if any	• Proper use of push-pull technology helps to sustainably and cost-effectively control nagana in cattle reared in high tsetse challenge areas • Because of their high volatility, only dilute repellants and attractants just before applying to cattle • There is need to involve cattle keepers when using the technology • Enhancing the capacity of cattle keepers improves the effectiveness of the push pull technology • Always remind farmers not to spray animals applied with attractants and repellants
Social, environmental, policy and market conditions necessary for the development and upscaling	• Acceptability of the technologyamong livestock keepers • The use repellants and attractants will not cause environmental pollutions and will not affect other not target insects • Guidelines on use of attractants and repellants to prevent pollution of the environment especially water masses if not properly done • The use of repellants and attractants will be in line with existing policy on control of vectors and vector-borne diseases • he efficacy of the repellants and attractants in the control of nagana should be high to stimulate their demand by the end usersPolicy
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 300/animal per week for treatment with an attractant/repellant

Estimated returns	• The use of push-pull technology will prevent 30% loss in cattle herds in high tsetse fly challenge areas
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have limited access to information and knowledge on the use of the technology. • Women may have limited access to education, training and extension services. • Cultural practices may limit women from performing the task • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities for youth males exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have limited access to education, training and extension services. • Due to their social status VMGs may often be excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit • Employment opportunities for youth males exist in performing the task
E: Case studies/profiles of success stories	
Success stories from previous similar projects	The push-pull technology is used on experimental basis at Kombani, Maganyakulo village, Kwale County. Mr Salim Mawele is among the smallholder dairy farers who has benefited from the use of this technology. He reported that the push-pull technology hasprotected his zero grazed dairy catle against nagana. Henoted that since he started using this technology, the need for treating nagana infected cattle reduced from twice a month to once in three months. This was confirmed by Mr Mohammed Kimbonja, South Coast Regional head of Kenya National Tsetse and Trypanosomiasis Control Council (KENTTEC)
Application guidelines for users	Mireji, P.O. et al., 2022. Perspectives on Odor- Based Control of Tsetse Flies in Africa. Frontiers in Physiology, DOI - 10.3389/fphys.2022.831618

F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires field validation
G: Contacts	
Contacts	Institute Director, KALRO Biotechnology Research Institute Muguga P.O. Box 362 -00902 Kikuyu
Lead organization and scientists	KALRO Biotechnology Research Institute, Muguga- Paul Mreji
Partner organizations	Kenya Tsetse and Trypanosmiasis Eradication (KenTTEC), Council, Kenyatta University, DVS, Bioinnovate, Gulu University, County Governments

RGaps

1. Validate the effectiveness of the technology in suppressing tsetse flies in different livestock production systems
2. Undertake economic analysis to determine the profitability of the technology

2.7.6 Protocol for Controlling Mastitis Dairy Animals

TIMP Name	**Protocol for Controlling Mastitis in Dairy Animals**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• LReduced milk yield in sub-clinical mastitis infected milking cows • hHigh postharvest losses due to sub-clinical mastitis which increases somatic cell counts thus high milk rejection cases at milk collection points or discarding of bad milk at the

What is it? (TIMP description)	TThe protocol for controlling mastitis involves regular screening of each quarter of the udder of milking animals just before milking. The screening is done using rapid penside tests such as the pH based paper strip kit, strip cup and California Mastitis Test (CMT). Screening results will identify, animals infected with mastitis for prompt treatment to minimize loss in milk production.  Screening for subclinical mastitis using CMT Source: KALRO
Justification	High prevalence of subclinical mastitis which can not be detected visually reduces milk output by about 33% and affects milk quality and marketability. Farmers have inadequate knowledge on management of mastitis in dairy animals. The protocol for controlling mastitis encourages regular screening and identification of animals with mastitis for prompt treatment. Healthy udders will produce milk with low somatic cell counts and reduces chances rejection. The protocol aims at minimizing losses in milk production and in milk rejections. It will also ensure that high quality milk is produced and marketed.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers, County veterinary and livestock staff, Certified Private animal health practitioners, Kenya Dairy Board (KDB), a g r i - p r e n e u r s , Milk processors.
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services

Critical/essential factors for successful promotion	• Dairy farmers' awareness about subclinical mastitis in • lactating camels • Willingness by dairy farmers to adopt the various testing kit technologies (CMT and pH-based testing methods) • Willingness by milk trader to pay premium price for quality milk delivered by producers.
Partners/stakeholders for scaling up and their roles	• KALRO - Research and information generation and sharing • Dairy farmers - End users. • County Governments - Extension services and capacity building. • Egerton University – Research and training • KALRO-Development and validation of mastitis control • Milk bulkers/ Cooperatives - End users and dissemination of information
C: Current situation and future scaling up	
Counties where already promoted if any	Isiolo, Marsabit, and Wajir
Counties where TIMP will be upscaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Lack of awareness on subclinical mastitis • Limited supply of the kit and awareness of its use • Inability to access camels given their frequent mobility in search of forage
Recommendations for addressing the challenges	• Create awareness on effects of mastitis and particularly subclinical on milk production • Capacity building on control and prevention of subclinical • Mastitis • Fast track the refinement, registration and commercialization of the pH based kit to involve farmers in mastitis control • Train pastoralists on use of the simple screening tests for identification of mastitis in camels
Lessons learned in up scaling if any	Involvement of farmers in screening milk animals makes it easier to adopt novel screeing kits

Social, environmental, policy and market conditions necessary for development and up scaling	• Acceptability of the mastitis control protocol among livestock keepers • The use mastitis control protocol will not cause environmental pollutions • The protocol will be in line with existing policy on animal disease control ACT CAP 364 • The protocol and especially screening kits have high sensitive and specific to properly identify mastitic udders from healthy ones to stimulate their demand by the end users Increased
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Cost of CMT reagent, labour and treatment with antibiotic gives a total cost of KES 350.00 per animal
Estimated returns	This returns will mostly be related to reduction of the milk losses due to mastitis. Farmers who successfully apply the protocol in the control of subclinical mastitis will have 33% of milk more milk compared to when cattle have the disease.
Gender issues and concerns in development and dissemination, adoption and scaling up	• Women and youth may have limited access to productive resources such as credit to purchase testing kits such as California Mastitis Test (CMT) kit for testing subclinical mastitis. • Women and youth may have limited knowledge of animal diseases due to lack of access to agricultural information and extension services.
Gender related opportunities	• Opportunity for youth to be trained in dairy health technologies • Adoption of dairy management technologies will benefit women and youth since there will be increased productivity hence increased income • Increases household income leading to more business opportunities • Food and nutrition security for youth and women
VMG issues and concerns in dissemination, adoption and scaling up	Visually impaired persons are disadvantaged since the technology is based on colour visualization
VMG related opportunities	• Adoption of mastitis management practice will lead to increased productivity hence increased incomes and improved food and nutrition security for VMGs • Business opportunities for VMG to sell more milk which is popular because of its health benefits
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Management of subclinical mastitis has successfully been promoted with increased milk productivity and reduced cases of rejected milk among the Salato women group in Ngurunit. Marsabit County and Anolei cooperative in Isiolo County.
Application guidelines for users	1. https://www.kalro.org/sites/default/files/Control-mastitis-for-hygienic-camel-milk-Dec2020.pdf 2. Camel Manual for trainers available at KALRO-VSRI, Muguga
F: Status of TIMP readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Institute Director, KALRO – VSRI, Muguga P.O. Box 32 -00902 KIKUYU, Kenya
Lead organization and scientists	KALRO VSRI (Peter Ndirangu and Monica Maichomo), KALRO – SGCRI Marsabit Amos Adongo
Partner organizations	MMUST and Kibabii University

2.7.7. Oil-Based Foot and Mouth Disease (FMD) Vaccine

2.7.7 TIMP name	**Oil-Based Foot and Mouth Disease (FMD) Vaccine**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• LReduced milk production due to high incidence of Foot and Mouth Disease (FMD). • High mortality in calves which significantly affects rearing of replacement heifers. • Causes animal welfare concerns particularly because of lameness and affects feeding due ulcers on the hooves mouth and on tongue. • Likelihood of mastitis developing in animals with FMD due to swellings and ulcers on the udder and teats. • Outbreaks of FMD lead to interruption trade due to livestock market closures. • Lost opportunity for the country to engage in international trade of livestock and livestock products since FMD is a trans-boundary animal disease

What is it? (TIMP description)	TOil based FMD vaccine is inactivated tissue culture FMD vaccine formulated in purified mineral oil adjuvant. The vaccine is administered under the skin for all cattle and goats at high risk of infection. The oil adjuvant prolongs the immunity in vaccinated animals
Justification	The current FMD vaccine is formulated in Aluminium hydroxide aqueous gel with saponin adjuvant. This formulation of vaccine confers short lived immunity and thus requires re-vaccination every 6 months or in some cases after every 4 months for better protection especially in FMD hotspot areas. The oil based FMD vaccine on the other hand is an mofied version of the aqueous preparation and confers immunity for a relatively long (12 months) time after primary vaccination. Repeat vaccination with oil based FMD vaccine is done annually hence reducing vaccination costs as well as minimizing animal welfare challenges. In addition, the vaccine requires relatively small dose administration (2ml in cattle) compared 3 ml when using the current preparation.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Animal health service providers, KEVEVAPI, agri-preneurs, farmers keeping dairy cattle and other cloven animals including dairy goats
Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services Training of Trainers (ToTs) and extension publications (leaflets, booklets, posters) Farmers Field Schools, local FM radio stations, Common Interest groups (CIG),
Critical/essential factors for successful promotion	• Training of animal health service providers on the new vaccine preparation • Sensitization of farmers on the new vaccine preparation • Production and distribution by KEVEVAPI through the Directorate of Veterinary Services and county veterinary department • Technology adoption and farmer feedback studies

Partners/stakeholders for scaling up and their roles	• KEVEVAPI – to produce and distribute the vaccine • Director of Veterinary Services - to monitor disease prevalence and effectiveness of the vaccine • County veterinary departments – to train the farmers and avail the vaccine • GALVmed-Promotion of the vaccine
C: Current situation and future scaling up	
Counties where already promoted if any	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot, Nyeri
Counties where TIMP will be up scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Weak extension services • Farmer reliance on vaccine supplies through vaccination campaigns • Inadequate extension publications • Availability of counterfeit vaccines
Suggestions for addressing the challenges	• Sensitize county governments on the effects of FMD outbreaks on milk production • SProduction of dissemination materials on oild based FMD vaccine • SStrengthen treaceability systems to identify counterfeit vaccines in the market
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and up scaling	• Awareness of smallholder farmers on the availability of the vaccine • The oil adjuvant will not have deleterious effects on the environment • The use of the oil based FMD vaccine will be as per the Animal control ACT CAP 364 • DThe oil based FMD is efficacious enough to stimulate continued production and distribution to the end users
Basic costs of the TIMP	KNot yet determined
Estimated returns when using the TIMP	4Not yet determined
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	

Gender issues and concerns in development, dissemination, adoption and scaling up	• GWomen may in most cultures are not the owners of cattle which may limit adoption of the innovation depending on the groups to be trained/sensitized • GWomen may have low vaccine adoption and use.
Gender related opportunities	• FMD control leads to increased milk production hence improved household nutrition and increased income. • Both genderThe youth may be involved in the commercialization of oil based FMD.
VMG issues and concerns in development, dissemination adoption and scaling up	• MVMGs may be sidelined in the use of the oil based FMD vaccine • VMGs may be disdvantaged when it comes to acquisition of user information on oil based FMD vaccine • TVMGs may not have the resources to acquire oild based FMD vaccine
VMG related opportunities	• Increased milk production hence improved nutrition and increased income • iIncreased involvement of VMGs in vaccine marketing • VMGs may get opportunities to train on service provision and agri-business skills
E: Case studies/profiles of success stories	
Success stories from previous similar projects	ONone
Application guidelines for users	RUser information available on the KEVEVAPI website - Products
F: Status of TIMP readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	Managing Director KEVEVAPI *P.O. Box 53260, Code: 00200.* Nairobi
Lead organization and scientists	KEVEVAPI Dr Alex Sabuni
Partner organizations	KALRO, VMD, DVS, County Governments

RGaps

1. Conduct quality control of on the oil based FMD vaccine during inactivation of the virus and formulating the vaccine in mineral oil to ensure it retains its efficacy
2. Conduct comparative studies to assess losses between dairy farmers using the aqueous FMD vaccine and those using oil based FMD vaccine
3. Conduct the effect of change of adjuvant on efficacy and safety of the vaccine

2.7.8 Protocol for Production of Contaminant-free Milk

2.7.8 TIMP name	Protocol for Production of Contaminant-free Milk
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Increased public health concerns on marketing and consumption of contaminated milk and milk products that may affect general human health. • Contaminants in milk negatively affects nutrition of high risk groups including infants, expectant mothers, and young children, the elderly and immune-compromised individuals who consume high volumes of milk and milk products. • Milk rejections and spoilage due to presence of contaminants significantly affects dairy farm profits and household nutrition.
What is it? (TIMP description)	A set of principles and procedures employed to reduce contaminants in milk from production from dairy animals to the eventual handling after milking. Adherence to the protocol prevents the introduction of chemical, physical and microbial contaminants into the milk. Minimizing common contaminants broadly include the use of safe feeds, clean animals, maintaining hygienic animal handling environment, adherence to drug withdrawal periods for treated animals, use of appropriate milking and storage equipment, milkmaid hygiene, milk testing and processing.
Justification	Milk is consumed by all communities worldwide and is considered the most nutritious and wholesome food. In Kenya, 80% of the milk produced by small holder farmers is marketed informally thus by-passing the formal safety and quality checks. Milk is a good medium for growth of micro-organisms that may cause diseases such as tuberculosis, brucellosis, Aflatoxicosis, listeriosis, gastrointestinal disorders and poisoning in humans. It may also carry chemicals, heavy metals and physical contaminants such as hair. The protocol is cheap to implement and will ensure production of quality and contaminant-free milk for consumption and processing thereby improving household nutrition and increasing incomes from sale of processed milk and milk products.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Milk producers and particularly smallholder farmers, agri-preneurs, milk processors

Approaches to be used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Regular extension visits to smallholder farmers to advise on clean milk production, environment hygiene and proper feed rations • Enforcement of quality milk regulations and control of informal marketing of milk by Kenya Dairy Board • Training of extension service providers in relevant counties as well as lead farmers on milk handling and processing • Supply and use of food grade milk handling and storage containers
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) – to advise and train on the different types of contaminants and how to reduce the risk of introduction into milk • Kenya Dairy Board - to ensure marketing of quality milk and milk products • Smallholder farmers – to keep healthy animals in clean environments and ensure production of milk free from contaminants. • Dairy cooperative societies – to guide farmers on milk to be delivered in milk collection points
C: Current situation and future scaling up	
Counties where already promoted if any	Nandi and Kisumu
Counties where TIMP will be up scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Weak extension services • Limited skills in milk processing • Inadequate extension publications
Suggestions for addressing the challenges	• Collaborate with partners with interest in provision of extension services • Sensitize county governments on public health risks arising from consumption of contaminated milk and milk

	products and the need to prioritize the health of milk producing animals • Training of smallholder farmers in feed ration formulation and storage • Training in herd/flock management, milking, storage and delivery to consumers • Availing farmer user materials
Lessons learned in up scaling if any	• Marketing of quality milk leads to improved household incomes and human nutrition
Social, environmental, policy and market conditions necessary for development and upscaling	• The protocol has socially acceptable practices • Adoption of practices that sustain safe milk production and marketing are environmentally friendly • Government regulations and policies support production of safe milk through extension. • Market exists for good quality milk in all milk production zones
Basic costs of the TIMP	Basic costs especially printing and photocopying (KES 100)
Estimated returns when using the TIMP	Not determined
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination, adoption and scaling up	• Women may have limited access to agricultural information, technology and knowledge • Women may have limited access to education, training and extension services. • Women may have limited access to resources such as credit, implements and inputs to implement the innovation. • Men dominate decision on livestock production and marketing at the household level
Gender related opportunities	• Affirmative action opportunities exist for women and youths to acquire the required credit • Employment opportunities for youths exist in performing the task
VMG issues and concerns in dissemination, adoption and scaling up	• VMGs may have limited access to agricultural information, technology and knowledge. • VMGs may also have limited access to finances to buy the required inputs such as mycotoxin binders and disinfectants. • VMGs may have limited access to education, training and extension services. • Due to their social status VMGs are often excluded from decision making in development and dissemination activities • There is low adoption by the VMGs due to lack of awareness
VMG related opportunities	• Affirmative action opportunities exist for VMGs to acquire the required credit • Employment opportunities for youths exist in performing the task
E: Case studies/profiles of success stories	

Success stories from previous similar projects	Kabiyet Dairy Cooperative (Nandi County) applied the TIMP which resulted in supply contaminant free milk with reduced cases of rejection by cooperative societies.
Application guidelines for users	https://www.kalro.org/guidelines-for-reducing-contaminants-in-raw-cattle-milk/
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	DInstitute Director KKALRO VSRI Muguga P.O Box 32 -00902 Kikuyu N
Lead organization and scientists	Ndirangu P.N. Omwenga S.G., Olum M.O., Maichomo M.W., Wesonga H.O., (VSRI Muguga, P.O Box 32, Kikuyu); Kipronoh A.K.(KALRO-DRI Naivasha, P,O Box 25, Naivash;, Mungube E.O. Mugambi J.M. and Kirigua V.O. (KALRO Hqts, P.O Box 57811, Nairobi)
Partner organizations	University of Nairobi, Directorate of Veterinary Services, Kenya Dairy Board

Research Gaps

1. Validate the protocol on-farm and on different animal species
2. Assess the ease with which the protocol is adopted amongst professionals and dairy farmers
3. Assess the willingness of the dairy farmers to adopt and pay for the costs associated with the protocol for the production of contaminant-free milk

2.7.9. Protocol for Reducing Infertility in Dairy Animals

2.7.9 TIMP name	**Protocol for Reducing Infertility in Dairy Animals**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Reduced productivity due to high incidence of infertility has proven to be very costly to the farmers and farming communities. • Economic losses associated with lost lactation time due to long inter-calving intervals. • Early culling which cause reduction in herd sizes because of poor health due to infections or nutritional deficiencies Increased cases of repeat inseminations which causes wastage of resources • HHigh prevalence of zoonotic diseases like brucellosis thus posing public health risk to humans from consumption of infected milk such as in the case of brucellosis or contact with the animals in cases of neosporosis among other infections.
What is it? (TIMP description)	Set of practices used for reducing infertility in cattle in small holder dairy herds thereby reducing the inter calving intervals. This reduces losses incurred by farmers by being able to: i)

	Identify animals with anatomical causes of infertility ii) Manage animals with physiological infertility due to hormonal imbalance iii) Manage nutritional causes of infertility through improved feeding iv) Detection and management of heat v) Utilization of Artificial insemination technology and fertility hormones as well as vi) Minimizing infertility caused by reproductive diseases/infections. These can be implemented at the farm level or with the assistance of animal health service providers.
Justification	DThe dairy sub-sector is dominated by smallholder farmers, who produce up to 80% of the total milk production. Despite the importance of the sub-sector, dairy farmers particularly the smallholders are still faced with many challenges, among them reproductive inefficiencies or infertility. Some farmers are are abandoning artificial insemination (AI) and embracing natural mating due to failures associated with AI.Among the causes of repeated AI is infertility. Infertility leads to reproductive wastage, losses in milk production, increased inter-calving intervals and sometimes ill health in affected animals. Implementation of these interventions will improve fertility and milk yield therefore improving livelihoods. It will reduce premature animal culling and increase the number of calves born.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Animal health service providers, Extension agents, Smallholder dairy farmers, dairy cooperatives, farmer groups, agri-preneurs, researchers.
Approaches to be used in dissemination	• TFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Regular extension visits to smallholder farmers to advice on reproduction and breeding • Supporting county subsidized AI programs to improve uptake. • Undertaking hormonal treatment on herds to improve fertility. • Training farmers on the importance of nutrition on fertility • Prompt treatment and observation of animals with symptoms of reproductive diseases • Dissemination of the manual on guidelines to reduce infertility.
Partners/stakeholders for scaling up and their roles	• KALRO – Development and validation of TIMPs • Extension service providers (public and private) – to be trained • County governments - Promotion of the practice

	• Smallholder farmers – to ensure interventions to reduce infertility are implemented. • Dairy cooperatives - share the information with members
C: Current situation and future scaling up	
Counties where already promoted if any	Kakamega, Nandi and Makueni
Counties where TIMP will be up scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia
Challenges in dissemination	• Risks involved in fertility hormone use such as abortions. • Unavailability of sufficient fodder for dairy cattle which is a cause to nutritional stress and infertility • Lack of skills in heat detection • Weak extension services and lack of skills in fertility hormone use
Suggestions for addressing the challenges	• Train service providers on the safe use of fertility hormones and estrus synchronization • Train on fodder cultivation and storage for production of enough feeds for optimal reproductive performance • Train farmers on heat detection and heat AI management
Lessons learned in upscaling if any	• Need to train farmers on fertility management and the importance of nutrition on fertility.
Social, environmental, policy and market conditions necessary for development and upscaling	• Willingness to adopt the protocol as a means of addressing infertility • The use of the protocol has no adverse environmental effects • Regulation of AI service providers by the Kenya Veterinary Board • Regulation of the use of fertility hormones by service providers • Regaining trust by farmers on subsidized AI offered by county governments
Basic costs of the TIMP	• Free
Estimated returns when using the TIMP	• Value of calves born every year if infertility is addressed – KES 25,000 • with infertility require at least 2 inseminations before conception. Sucessful application of protocol reduces infertility and reduces the need for repeated inseminations. Farmers save KES 1500 paid per every repeat insemination.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Gender issues and concerns in development, dissemination, adoption and scaling up	• Some farmers do not have the ability to afford AI or fertility hormones for fertility interventions.
Gender related opportunities	• Regular calving intervals is associated with increased milk production hence improved household nutrition, increased income, increased involvement of women and youth in milk marketing.

	• Involvement of women and youth as service providers in fertility related services
VMG issues and concerns in development, dissemination adoption and scaling up	• oneTraining on fodder production can be an agribusiness venture for these groups
VMG related opportunities	• Increased milk production hence improved nutrition and increased income, increased involvement of VMGs in milk marketing, need to train them on value addition and agri-business skills • Training on fodder production can be an agribusiness venture for these groups
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Kakamega and Nandi County governments and farmers have had experience with fertility clinics and calves were born.
Application guidelines for users	Guidelines to reduce infertility in small holder dairy cattle available on the KALRO website
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Institute Director KKALRO VSRI Muguga P.O Box 32 -00902 NKikuyu
Lead organization and scientists	KALRO VSRI - Moses Olum, Monicah Maichomo, Peter Mwangi and Erick Mungube, KALRO Headquarters
Partner organizations	University of Nairobi, Directorate of Veterinary Services, Various County Governments

Research Gaps

1. Validate the protocol on-farm and on different animal species
2. Assess the easy with which the protocol is adopted amongst professionals and dairy farmers
3. Assess willingness of the dairy farmers to adopt and pay for the costs associated with the protocol for reducing infertility

2.7.10 Protein tagged Latex Agglutination Test for Contagious Bovine Pleuro-pneumonia

2.7.10 TIMP name	**Protein tagged Latex Agglutination Test for Contagious Bovine Pleuro-pneumonia**
Category (i.e. technology, innovation or management	Technology
A: Description of the technology, innovation or management practice	

Problem to be addressed	• Low productivity due to high incidence of CBBP, • Lack of a test to differentiate antibodies from infection and those from vaccination • Disruptions in trade of livestock and livestock products due to quarantines and restricted movement  An animal gasping for breath due to CBBP Source: KALRO
What is it? (TIMP description)	This is a rapid and simple pen-side strip test embedded with a protein marker that is specific to the CBPP DIVA vaccine. The strip test forms a band when in contact with antibodies against CBPP found in exposed or vaccinated animals. The test forms a second band when in contact with antibodies specific to a protein in animals vaccinated with the CBPP DIVA vaccine thus differentiating animals vaccinated with the CBPP DIVA from infected animals. It is a field-based test that is used alongside the CBPP DIVA vaccine and suitable for use in ASALs where the CBPP is prevalent.
Justification	Contagious Bovine Pleuro-pneumonia is a trans-boundary disease that lowers cattle productivity and has important consequences on international trade. As such detection of the disease in an area attracts trade barriers and restrictions. Current diagnostic tests are laboratory based, costly, time consuming and require use of skilled personnel and equipment. In addition, they lack DIVA properties as they cannot differentiate between truly infected animals from those that have been vaccinated. The protein tagged Latex Agglutination CBPP diagnostic test addresses the limitations of the current CBPP diagnostic tests and is important for effective and rapid detection of CBPP for decreased productivity and economic losses and reduction in trade barriers along the beef value chain. The test will support informed decision making on the use of vaccines/drugs in control of CBPP.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy cattle keepers, Researchers, Beef traders associations, Beef Breeder associations, DVS, County Governments Private animal health practitioners, agri-preneurs, Extension service providers

Approaches to be used in dissemination	• AgriculturalFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Availability of reagents and other consumables • Availability of effective marketing channels for the kit • Adequate infrastructural capacity to produce and
Partners/stakeholders for scaling up and their roles	• DVS- Policy and regulation • County Governments- End users, extension services • Private animal health practitioners-End users). • Provide technical backstopping and training of trainers
	• Extension service providers (Public and private) - to offer advice and collect information on the uptake of the kit. They will also ensure proper use of the kit. • County Governments- Promote and create awareness on the advantages of the kit • DVS -Policy and regulation on use of the kit • VMD-Registration of the kit • Pastoralists, farmers and farmer groups-will spread livestock owners and the end-users. • AU-PANVAC- Ensure quality assurance • Private Institutions-production, Commercialization
C: Current situation and future scaling up	
Counties where already promoted if any	Garissa, Marsabit Tana River, Isiolo, Tharaka Nithi, Taita Taveta, Laikipia, Bomet, Elgeyo Marakwet, Kajiado
Counties where TIMP will be up scaled	Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia,
Challenges in dissemination	• Low awareness of the technology • Inadequate capacity to use the kit by extension workers and pastoralists • Lack of appropriate diagnostic kit marketing channels

Recommendations for addressing the challenges	• Promotion to raise awareness of the technology. • Capacity building of extension workers and pastoralists on use of the kit • Collaboration with private institutions to enhance kit production and commercialization.
Lessons learned in up scaling if any	• Collaboration with partners with comparative advantages results in successful uptake of the vaccine • Proper guideline on kit application including type and state of samples compatible with the kit will enhance its accurate use.
Social, environmental, policy and market conditions necessary for development and up scaling	• Acceptability of the kit for diagnosis of CBPP in Kenya and the sub-Saharan Africa region • Use of the kit has no negative effect on the environment • Need for policy to guide the incorporation of kit in detection and control of CBPP in Kenya • Need to register the kit with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 100 per test
Estimated returns	Estimated current cost of CFT CBPP test is KES 400 per test therefore use of CBPP agglutination test reduces costs by KES 300 per test. DThe kit has an added advantage of differentiating vaccinated animals from infected animals, the test reduces losses due to decreased market value
Gender issues and concerns in development, dissemination, adoption and scaling up	• Limitations in information access due to gender inequalities in education • Gender inequalities in resources and decision making may limit access to the kit • Limited time and mobility or women to attend extension activities due to conflicting responsibilities
Gender related opportunities	• Increased opportunities for youth involvement in CBPP testing and marketing of the kit
VMG issues and concerns in development, dissemination, adoption and scaling up	• VMGs may face barriers in accessing information • Due to their social status VMGs may be excluded from decision making during upscaling • VMGs face barriers in accessing resources such as credit
VMG related opportunities	Increased opportunities for youth involvement in CBPP testing and marketing of the kit
E: Case studies/profiles of success stories	
Success stories from previous similar projects	None

Application guidelines for users	None
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires Validation
G: Contacts	
Contacts	Institute Director, Biotechnology Research Institute, KALRO P.O. Box 362-00902 Kikuyu email: director.biori@kalro.org
Lead organization and scientists	KALRO BIORI –Mwirigi Martin
Partner organizations	DVS, County Governments

2.7.11 Sub-unit Contagious Bovine Pleuro-pneumonia (CBPP) Vaccine

2.7.11 TIMP name	**Sub-unit Contagious Bovine Pleuro-pneumonia (CBPP) Vaccine**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	• Restricted use of the current T1/44 CBPP vaccine because the vaccine is reactive and causes tails of vaccinated cattle to fall off • The T1/44 CBPP vaccine requires cold chain • Lacks DIVA properties (difficulty to differentiate antibodies from the vaccine and those from natural field infection)
What is it? (TIMP description)	The sub-unit CBPP vaccine is formulated from specific proteins from *Mycoplasma* which confer immunity to vaccinated cattle thus giving sufficient protection to cattle against CBPP. Being protein based, sub-unit CBPP vaccine is thermo-tolerant and does not require cold chain for storage. The vaccine is also safe, cost-effective and can be used with minimal restrictions for the sustainable control of CBPP in Kenya and the sub-Sahara Africa region.
Justification	Although CBPP, is an important trans-boundary animal disease, the use of the current T1/44 CBPP vaccine is highly regulated by the DVS which limits vaccination coverage. Similarly, the adverse reactions in vaccinated cattle where tails fall off discourage farmers from adopting the vaccine. The T1/44 requires cold chain for its storage for it to retain efficacy which makes it unsuitable for use in areas with low electricity connectivity. These drawbacks have justified the need for an efficacious, safe and appropriate vaccine for the wide use even in marginal areas with limited electricity connectivity. The sub-unit CBPP vaccine under development is

	thermo-tolerant CBPP vaccine, safe and cost-effective for the sustainable control of CBPP. The use of the sub-unit CBPP vaccine will not lessen regulatory controls leading to wider adoption and vaccination coverage.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy cattle keepers, County Governments, DVS, AU-PANVAC, FAO, agri-preneurs
Approaches to be used in dissemination	• AgriculturalFarmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dqashboards, Apps, social media short message services
Critical/essential factors for successful promotion	• Ensure proper selection of adjuvants for formulating the vaccine to minimize adverse reactions • Winvolve KEVEVAPI the veterinary vaccines commercial producer in the development of th sub-unit CBPP vaccine • Ensure full involvement of the regulators (VMD, DVS, NACOSTI, the Kenya Veterinary Board (KVB)) during the development phase
Partners/stakeholders for scaling up and their roles	• KALRO-vaccine development • ,DVS - Policy and regulation • County Governments-extension services • KEVEVAPI-vaccine manufacturer • VMD-registration of vaccine • FAO-User of the vaccine • GALVmed-promotion of the vaccine
C: Current situation and future scaling up	
Counties where already promoted if any	None
Challenges in dissemination	Yet to be determined
Recommendations for addressing the challenges	None
Lessons learned in up scaling if any	None
Social, environmental, policy and market conditions necessary for development and upscaling	i) It is expected that the vaccine will be acceptable across board ii) The attributes of the vaccine especially thermo-stability will be retained in dairy production systems in the different agro-ecological zones

	iii) Once validated under field conditions, the VMD will authorize the use of the vaccine iv) There is need to lobby DVS to relax the supervision of vaccinations to allow involvement of private service providers v) There will be demand for the vaccine in controlling CBPP
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Yet to be determined
Estimated returns	Yet to be determined
Gender issues and concerns in development and dissemination	• Lower Limitations in information access due to gender inequalities in education • Lower participation of women in vaccine dissemination activities due to cultural barriers • Gender inequalities in resource ownership and decision making may limit access of women and youth to the vaccine • Restraining of animals during vaccination may present a challenge to women • Cultural practices that limit participation of certain gender categories in various aspects beef production including vaccination and distribution of vaccines • Limited time and mobility for women to attend extension activities when there are conflicting roles
Gender related opportunities	• Potential for knowledgeable persons to be privately involved in carrying out vaccinations since the DVS will relax the vaccination rule
VMG issues and concerns in development and dissemination	• Due to their social status VMGs may often be excluded from decision making during dissemination of technologies • VMGs may face barriers in accessing resources such as credit and information • VMGs may often be excluded from accessing and benefitting from technologies • Restraining of animals during vaccination may present a challenge to VMGs • The technology is labour intensive and very technical may require VMGs to hire service providers
VMG related opportunities	Potential for knowledgeable VMGs to be privately involved in carrying out vaccinations since the DVS will relax the vaccination rule
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Yet to be documented
Application guidelines for users	To be developed

F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Requires validation
G: Contacts	
Contacts	KALRO – VSRI, Muguga North P.O. Box 32 - 00902 KIKUYU, Kenya
Lead organization and scientists	KALRO-VSRI Muguga, Hezron Wesonga
Partner organizations	KEVEVAPI, VIDO Canada, ILRI,

Research Gaps

1. Assess the effectiveness of the nebulization and intubation challenge models to achieve infectivity thresholds for sub-unit CBPP vaccine to be declared as protective
2. Validate the sub-unit CBPP vaccine for its efficacy in the control of CBPP in the beef production zones
3. Determine the cost-benefit of the sub-unit vaccine in the control of CBPP
4. Assess development, adoption and scaling up of the technology with gender and VMGs in consideration

2.8 Dairy Cattle Commercialization, Marketing, and Policy Options

2.8.1 Dairy Cattle Commercialization

2.8.1 TIMP name	**Dairy commercialization**
Category (i.e. technology, innovation, or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	• Low incomes due inadequate commercialization of smallholder dairy farming • Low usage of essential agribusiness tools by small-holder dairy farmers particularly cost analysis, affecting their profitability • Lack the fundamental business planning and financial skills required for effective management and growth within the dairy sector.
What is it? (TIMP description)	TDairy commercialization is a practice which is intended to offer comprehensive support to dairy farmers with a decision-making tool using evidence-based, data-driven statistical analysis. By harnessing the power of business knowledge and conducting in-depth enterprise performance computations, this practice equips farmers with the means to effectively evaluate the financial health of their dairy enterprises. This includes the ability to discern whether their operations are operating at a profit or incurring losses, a crucial aspect that can vary under different production systems. Moreover, this management

	practice serves as a valuable transition tool for farmers, facilitating their shift from subsistence-level dairy production to a more commercial and sustainable approach. Through a wealth of information, strategic guidance, and data-driven decision-making, farmers can elevate their dairy enterprises to a commercial level, thereby improving their economic prospects and ensuring long-term viability in the dairy industry. The tool can be used for all dairy farm products including milk, milk products, hay, forages and manure among others.
Justification	The TIMP is dedicated to empowering these farmers with the knowledge and tools necessary to overcome these challenges, ultimately enabling them to make more informed, profitable, and sustainable decisions within the dynamic landscape of the dairy industry. The rationale for developing this management practice is rooted in the prevailing challenges faced by dairy farmers in trying to transit from subsistence to commercial farming. Currently, many dairy farmers are on subsistence production practices, with limited attention to crucial aspects like costing and gross margin analysis of the different dairy products. These elements are not only pivotal in determining the profitability of their dairy enterprises but also serve as vital indicators of the overall performance status of their ventures. Furthermore, there is inadequate record-keeping among dairy farmers which affects profitability analysis due to lack of credible data. This deficiency often forces farmers to rely on memory-based data recall, which, in turn, can yield inaccurate results and lead to misguided agribusiness advisories. Thus, the development of this management practice is essential to bridge these Gaps, empowering dairy farmers with the tools and knowledge needed to transition from subsistence farming to a more profitable, sustainable, and informed approach to dairy production.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers , Extension agents, Service providers, agri-preneurs, Researchers
Approaches used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services

	• Presentations, discussions, role play and practical groups exercises
Critical/essential factors for successful promotion	• Farmers' understanding dairy business aspects and simple cost computations. Farmers should have a profound understanding of the various aspects of dairy business operations, including the ability to conduct straightforward cost and revenue computations. This knowledge is foundational for sound financial decision-making. • Understanding the importance of business planning and development • Presence of friendly regulations, legislation and policies in the Dairy sector • Tailor made training programme taking care of issues of gender and education of the farmers
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private)-to train farmers and give timely information on dairy commercialization, Business planning and entrepreneurship. • KALRO-Technology development and fine tuning, ToT, backstopping and monitor implementation • Farmer groups-Adoption and utilization of Technologies, Innovations, management practices and related information. • Kenya Bureau of Standards (KEBs)-Quality assurance and standardization
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua and Laikipia
Counties where TIMP will be upscaled	AKilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans Nzoia
Challenges in dissemination	• Diverse Literacy Levels: Farmers often exhibit varying literacy levels, which can hinder effective communication and comprehension of training materials. This TIMP requires basic analytical and computational skills for effective delivery. • Subsistence Mindset: Shifting farmers' focus from subsistence production to viewing dairy as a business can be a significant hurdle. • Resistance to Change: Some farmers may resist adopting new technologies and practices, as they may be comfortable with traditional methods.

Recommendations for addressing the challenges	• Capacity building of trainer (lead farmer) who will train farmers on commercializing their dairy enterprises with a focus on cost benefit analysis, Farm economic analysis, dairy entrepreneurship among others • Comprehensive training and support to enhance financial and data analysis capabilities. • Encouraging farmers to embrace commercialization means altering their mindset, emphasizing profit generation, and instilling business-oriented practices. • Tailored approaches and materials are necessary to accommodate these differences and ensure that all farmers, regardless of their literacy level, can participate in the training successfully. • Basic computer training • Availability of computers and other IT equipment including smart phones • Engage locals as trainers so as to use vernacular language where need be.
Lessons learned	The dairy commercialization management practice significantly strengthens the profitability, competitiveness, and long-term sustainability of dairy businesses. This practice equips farmers with the essential skills and knowledge needed for successful commercialization, reinforcing its position as a cornerstone in elevating both their income and overall economic returns, with a specific emphasis on household-level improvements. It serves as a beacon of transformation, empowering farmers to make the crucial transition from subsistence to commercial farming, ultimately fostering financial stability and playing a pivotal role in advancing the prosperity of farming communities
Social, environmental, policy, and market conditions are necessary	• Social acceptance of dairy products to propel the commercialization of dairy farming by creating a reliable and expanding market for farmers' produce. Moreover, social acceptance can foster trust and positive perceptions of the quality and safety of dairy products, further stimulating their commercial success • Sustainable practices which promote environmentally sustainable dairy farming practices such as waste management • Supportive Regulations: There should be an enabled business environment with friendly regulations and legislation that supports dairy commercialization and offers incentives to participating farmers. • Access to markets and streamlining trade policies to ensure favorable conditions for dairy products.

	• Expanding and diversifying dairy markets to accommodate increased production and create demand for dairy products. • Sustainable practices which promote environmentally sustainable dairy farming practices such as waste management
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 20-100 for buying data connectivity to use the relevant analytical tools. The associated charges are based on individual service providers.
Estimated returns	INot determined
Gender issues and concerns in development, dissemination, adoption and scaling up	• Access and control of resources including inputs and revenues from milk and milk product sales • Access to Resources: Gender disparities in access to resources such as land, credit, and technology can hinder women's active participation in dairy commercialization. • Workload Distribution: Women may often bear the brunt of domestic and caregiving responsibilities. The adoption of dairy commercialization may increase their workload, requiring solutions to balance responsibilities effectively. • Decision-Making Power: In some farming communities, women may have limited decision-making power. Inclusivity in decision-making related to dairy commercialization is essential to ensure their voices are heard. • Training and Capacity Building: Tailored training programs that consider women's literacy levels and learning preferences are crucial to provide equal opportunities for both genders to acquire the necessary skills. • Market Access: Ensuring that women may have equal access to markets and opportunities to sell their dairy products is important. • Extension Services: Outreach programs should reach both men and women farmers with relevant information and support services.
Gender related opportunities	• Youths, women and men can carry out business analytical services as a paid undertaking • Economic Empowerment through commercialization can lead to increased income and financial independence, allowing more control over household resources and decision-making especially for women. • Women often play a central role in processing and value addition activities related to dairy products. This can

	create opportunities for them to develop and market value-added dairy products. • Skills development through the training and capacity-building programs tailored for women in the dairy sector can enhance their skills and knowledge, enabling them to actively engage in commercialization. • Entrepreneurship: Dairy commercialization offers women the opportunity to become entrepreneurs by managing their own dairy enterprises, thereby contributing to economic growth.
VMG issues and concerns in development, dissemination adoption and scaling up	• Limited Access to Resources: VMGs may often have restricted access to essential resources like land, capital, and technology, which hinders their participation in commercial dairy farming. • Social and Economic Vulnerability: VMGs may have more susceptible to economic shocks and disruptions, which can affect their ability to invest in and sustain commercial dairy enterprises. • Inadequate Training and Capacity: VMGs may have limited access to training and capacity-building opportunities, leaving them with inadequate knowledge and skills for dairy commercialization. • Access to Markets: VMGs may encounter difficulties in accessing markets, finding buyers, and selling their dairy products, limiting their ability to benefit from commercialization. • Social discrimination: Discrimination and social norms can restrict VMGs' opportunities and influence their roles and decision-making within dairy enterprises. • Infrastructure and Technology: Inadequate infrastructure and technology in marginalized areas can hinder the adoption of modern dairy farming practices. • Training programs not accommodating materials in accessible formats e.g. sign language interpreters, and physical facilities that are wheelchair-friendly
VMG related opportunities	• Training to enable VMGs effectively carry out dairy enterprise business analysis • Income Generation: VMGs can increase their income through dairy commercialization, creating a reliable source of revenue for their households. • Economic Empowerment: Engaging in dairy commercialization can lead to greater economic independence, reducing dependence on external support and enhancing their financial well-being. • Food Security: VMGs can benefit from improved access to dairy products, enhancing the nutritional

	quality of their diets and contributing to household food security. • Entrepreneurship: VMGs can explore entrepreneurial opportunities within the dairy value chain, such as dairy processing, value-added product development, or even establishing small-scale dairy businesses. • Skills Development: Training provides VMGs with valuable skills and knowledge related to dairy farming, business management, and marketing, enabling them to effectively manage their dairy enterprises. • Market Access: VMGs can benefit from broader market access, enabling them to sell their dairy products more effectively and generate higher income. • Social Inclusion: Active involvement in dairy commercialization can help integrate VMGs into their local communities and empower them to participate in community decision-making.
E: Case studies/profiles of success stories	
Success stories	KALRO Dairy Research Centre Ol Joro Orok, Nyandarua County has been able to significantly increase incomes from dairy production through application of agribusiness and technical advisories as well as economic analysis reports.
Application guidelines for users	-Per unit cost calculation tool software available at https://www.thescanfoundation.org
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Centre Director, KALRO Dairy Research Centre/Ol joro orok P.O Box 200-20302 Ol Joro Orok kalrooljk@kalro.org
Lead organization and scientists	KALRO N. Mathai, A. Murage, , E. Chelimo, B. Wachira, N. Kanegeni, E Nyambati
Partner organizations	Ministry of Agriculture and Livestock Development (MoALD), Kenya Dairy Board, Kenya Bureau of Standards (KEBs)

2.8.2 Dairy cattle marketing

2.8.2 TIMP name	**Dairy Marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem addressed	• Disorganized and poorly regulated milk marketing channels • Insufficient information on markets for milk, by products and input. • FInadequate knowledge on market dynamics and their effect on prices.
What is it? (TIMP description)	The TIMP is designed to equip farmers with essential information, skills, and knowledge to excel in the competitive dairy market. Farmers will gain a deep understanding of efficient markets, market dynamics, and key linkages within the dairy value chain. They will also explore consumer preferences and delve into the economics of product pricing. By perfecting the skills needed to connect farmers with various market opportunities, this practice aims to maximize dairy output and sales, ultimately promoting a thriving and prosperous dairy business, transiting from subsistence to commercial venture.
Justification	TIn order to transition from subsistence to commercial dairy farming, farmers must possess essential business planning skills, a critical prerequisite for effective enterprise management and maximizing earnings. Additionally, a pressing need exists for enhancing their skills in marketing dairy products, while understanding the complexity of market price determination and dynamics. Often, dairy farmers grapple with persistently low prices for their milk and dairy products, dissuading them from fully realizing the potential of dairy farming. Disorganized milk markets further compound this issue, disrupting the seamless flow of dairy products from the farmer. To address these challenges, it is crucial to bridge the business planning Gap and equip farmers with the tools and knowledge to diversify their dairy enterprises strategically, targeting specific niche markets. By doing so, we empower dairy farmers to not only thrive but to unlock the full potential of the dairy value chain, ultimately enhancing their financial resilience and promoting a more prosperous dairy sector.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers and stakeholders in the dairy value chain
Approaches used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print

	• Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services • Presentations, discussions, role play and practical groups exercises
Critical/essential factors for successful promotion	• Enabling regulatory framework characterized by friendly regulations, legislation, and policies that support and facilitate dairy marketing efforts. • Inclusive value chain integration incorporating all stakeholders along the dairy value chain • Designing tailored training programs to the specific needs, knowledge levels, and constraints of the target farmers, ensuring the content is relevant and accessible. • Well trained facilitators who are knowledgeable in dairy marketing and possess effective training and communication skills. • Provide farmers with access to essential resources, including market information, market linkages, and financial support to kick start their marketing efforts. • Incorporate practical exercises, demonstrations, and real-life case studies to enhance farmers' understanding of marketing concepts and strategies • Farmer Networks: Encourage the formation of farmer networks and cooperatives to collectively access markets and negotiate better prices. • Supportive Organizations: Collaborate with agricultural and dairy associations, NGOs, and extension services to strengthen the marketing capacities of farmers
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private) - to train farmers and give timely information on markets and market information • KALRO - technology development and fine tuning, ToT, backstopping and monitor implementation • Farmer groups - Adoption and utilization of Technologies, Innovations, management practices and related information.
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua/Nairobi/Kiambu
Counties where TIMP will be upscaled	AKilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Trans-Nzoia

Challenges in dissemination	• Varying education levels of the farmers, and some may have limited formal education, making it essential to tailor training materials to diverse learning needs. • Farmers may experience low motivation due to historically poor market prices, necessitating efforts to boost their confidence and enthusiasm for engaging in dairy marketing. • Limited access to markets, insufficient market information, and a lack of marketing skills among farmers can impede their ability to make informed marketing decisions. • Middlemen and other actors along the dairy value chain can exert significant influence, potentially limiting farmers' independence and returns. • Farmers may lack comprehensive knowledge of the ever-evolving dynamics of dairy product marketing • The seasonality of dairy products often leads to price fluctuations, impacting the stability of farmers' income and market opportunities. • Insufficient knowledge on post-harvest handling and storage for dairy products • Existing policy regulations in the Dairy industry and whether they are favourable to dairy producers.
Recommendations for addressing the challenges	• Enhanced Marketing Skills: Provide comprehensive training to equip farmers with the marketing skills needed such as market analysis, pricing strategies, and customer relationship management. • Inclusivity and Coordination of all dairy value chain actors, including farmers, processors, and intermediaries, to ensure seamless market operations and promote collaboration. • Capacity Building of farmers with a specific focus on markets and market information. • Formation of Farmers Groups to enhance their bargaining power in the market. • Capacity Building of Chain Actors to enhance market efficiency and fairness. • Customized Training: Tailor training materials to suit farmers with varying levels of education.
Lessons learned	• Tailored marketing strategies are important as “one-size-fits-all” marketing strategies may not work for all farmers. • A comprehensive market information system is important to provide farmers with up-to-date data on prevailing market conditions, including demand trends, pricing fluctuations, and consumer preferences.

	• Real-time price indices enable farmers to make informed decisions about when and where to sell their dairy products, ultimately maximizing their returns. • Continuous market research is crucial to understand the evolving preferences of consumers and the dynamics of the dairy market helps in adapting marketing strategies. • Encouraging farmers to move beyond raw milk production by adding value to dairy products can significantly increase the profitability of their dairy businesses. • Emphasizing the importance of maintaining high-quality standards in dairy production is essential for accessing premium markets and building consumer trust. • Cooperative model can help small-scale farmers access better markets and negotiate better prices. • Strong market linkages can ensure a smooth flow of products from the farm to the market, reducing post-harvest losses and ensuring timely deliveries. • Digital platforms can help farmers stay informed about market trends, connect with buyers, and manage their businesses more efficiently.
Social, environmental, policy and market conditions necessary for development and upscaling	• Consider cultural norms and social structures that may influence marketing practices. • Ensure that farmers have access to training resources, such as training materials, instructors, and facilities. • Ensure gender equity in training programs. • Consider the local climate and geographic location, as they can affect the seasonality of milk production and the availability of resources for dairy farming. • Assess the availability of infrastructure such as roads, transportation, and electricity, which can impact the logistics of marketing dairy products. • Promote environmentally sustainable farming practices, as these can affect not only the environment but also consumers' perception of the products. • Ensure that the policy and regulatory framework supports dairy marketing practices. • Farmers should be aware of and comply with relevant policies, regulations and standards related to food safety, labeling, and quality. • Consider the policies and regulations related to market access, such as trade barriers or subsidies that can impact the competitiveness of dairy products in local and international markets.

	• An existing market demand for dairy products and consumer preferences.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Dairy marketing information will be available for free from the identified Lead farmer in their locality
Estimated returns	It is expected that farmers utilizing this information will experience increased market access and participation resulting in sustainable and economically viable dairy enterprises.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Youth are more engaged in collection and transportation of milk almost exclusively reserved for male youth • Employment at Milk Collection Centres (MCCs) is also male-dominated, especially in management and field-related operations; • Gender disparities in access and ownership of resources that may affects participation in the enterprise • Skewed access to training and extension services, which can lead to a knowledge Gap in modern dairy marketing practices. • Traditional gender roles may limit women's participation in decision-making regarding dairy marketing and business development. • Limited Control over the income generated from dairy farming, which can hinder ability to invest in marketing efforts. • Double Work Burden: Women often juggle multiple responsibilities, including household chores and caregiving, in addition to dairy farming. • Gender-based barriers may prevent women from entering certain markets or engaging in negotiations with buyers. • Cultural norms in some regions may restrict women from engaging in public or entrepreneurial activities, including marketing.
Gender related opportunities	• Inclusive decision-making processesThere is an opportunity for involving the youths as service provision in assisting to develop markets and milk marketing models and in the process some income
VMG issues and concerns in development, dissemination adoption and scaling up	• Organizing VMGs for collective marketing of dairy products • VMG individuals or groups may have limited access to land and livestock, which are fundamental resources for dairy farming and marketing. • Lower literacy rates among VMG groups can pose challenges in accessing and understanding training materials and market information.

	• Language disparities may create difficulties in disseminating information and training materials • VMG individuals may face discrimination when attempting to access markets or negotiate prices for their dairy products. • Some VMG groups may reside in remote or isolated areas, making it challenging to reach markets and access transportation infrastructure.
VMG related opportunities	• Tailoring marketing development programs to the specific needs of VMG individuals or groups, offering customized training and resources. • Implementing policies and practices that combat discrimination based on gender, caste, ethnicity, or other factors. • Fostering the economic and social empowerment of VMG individuals through capacity-building, education, and awareness campaigns. • Ensuring that VMG individuals are adequately represented and have a voice in dairy marketing organizations and cooperatives. • Creating value chains that incorporate VMG groups at multiple stages, from production to processing and marketing.
E: Case studies/profiles of success stories	
Success stories	Umoja Dairy Cooperative, Nyandarua County
Application guidelines for users	Smart Marketing Manual (USAID)
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Institute Director KALRO Dairy Research Institute/Naivasha P.O Box 25-20117 Naivasha director.dri@kalro.org Or Centre Director, KALRO Dairy Research Centre/Ol joro orok P.O Box 200-20302 Ol joro orok kalrooljk@kalro.org
Lead organization and scientists	KALRO N. Mathai, A. Murage, , E. Chelimo, B. Wachira, N. Kanegeni, E. Nyambati
Partner organizations	Ministry of Agriculture Livestock and Fisheries, Kenya

2.8.3 Dairy cattle Policy options and regulations

2.8.3 TIMP name	Policy options and regulations
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	• Inadequate awareness of the policies and regulations in the dairy sector, including critical aspects related to production, by small holder farmers. • The knowledge Gap limits farmers' ability to comply and take full advantage of opportunities for sustainable and profitable farming.
What is it? (TIMP description)	This policy options and regulations for dairy cattle is an essential tool in farm management as it provides farmers with structured framework for operating legally, improving product quality, gaining market access, adopting sustainable practices, and advocating for their needs. By adhering to policies and regulations, farmers can enhance their economic prospects and contribute to the overall sustainability and success of the agricultural sector
Justification	Training farmers on policies and regulations in the dairy sector is paramount as it addresses a significant knowledge Gap that hinders farmers from understanding and complying with critical legal requirements. This lack of awareness can lead to unintended violations, penalties, and legal challenges. Moreover, compliance with stringent standards for dairy products' quality, hygiene, and safety is essential to safeguard consumers' health and enhance the reputation of dairy products. Access to local and international markets is often contingent on adherence to specific regulations, and without proper knowledge, farmers may miss out on lucrative market opportunities, limiting their income potential. Additionally, understanding and adhering to environmental regulations is crucial for the long-term sustainability of dairy farming practices. Government policies frequently offer financial incentives and support programs for smallholder dairy farmers, and training is essential to help them access these opportunities, reduce production costs, and increase profitability. Knowledge of policies also empowers farmers to participate in shaping agricultural policies that benefit their sector, fosters innovation and responsible practices, and ultimately contributes to economic empowerment and the overall success of smallholder farmers and the dairy industry
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers, agri-preneurs and stakeholders in the dairy value chain.

Approaches used in dissemination	• Farmer Field and Business School (FFBS) • Agricultural innovation platforms (AIP) • Demonstrations - On-farm and on station • Agricultural shows/exhibitions/field days • Trainings - workshops/Seminars/Meetings • Public and private Extension Agents • Farmer to farmer extension models • Mass media – Electronic and print • Publications-posters/brochures/leaflets, manuals • Digital Platforms-Website, Dashboards, Apps, social media short message services • Presentations and group discussions
Critical/essential factors for successful promotion	• Relevance-training programs tailored to the specific needs and challenges faced by smallholder dairy farmers. • Accessibility-training materials and sessions should be easily accessible to smallholder farmers, including those in rural or remote areas. • Simplicity- training content should be presented in a clear and understandable manner, avoiding overly technical or legal jargon. • Participatory Learning - engage farmers actively through participatory learning methods, group discussions, case studies, and practical demonstrations to ensure better knowledge retention and application. • Inclusivity-consider the diverse needs of smallholder dairy farmers, including women and youth, and design training programs that are inclusive and equitable.
Partners/stakeholders for scaling up and their roles	• Extension service providers (public and private)-to train farmers and give timely information on current policies and regulations governing the dairy industry. • KALRO-Technology development and fine tuning, ToT, backstopping and monitor implementation • Farmer groups-Adoption and utilization of Technologies, Innovations, management practices and related information.
C: Current situation and future scaling up	
Counties where already promoted if any	None
Counties where TIMP will be upscaled	All dairy counties under NAVCDP project; Kilifi, Meru, Bomet, Bungoma, Busia, Embu, Homa Bay, Taita Taveta, Kajiado, Kakamega, Kericho, Kiambu, Nyeri, Kirinyaga, Migori, Kisii, Muranga, Kisumu, Nakuru, Nandi, Narok, Machakos, Uasin Gishu, Nyamira, Makueni, Nyandarua, Vihiga, Tharaka Nithi, Transnzoia

Challenges in dissemination	• Complexity of Legal jargon: Policies and regulations are often written in complex legal language that can be difficult for farmers to understand, leading to confusion and misinterpretation. • Diversity of the audiences: Farmers come from diverse backgrounds, and one-size-fits-all training may not address the specific needs of different groups • Awareness Gaps: Farmers may lack awareness regarding the existence or relevance of specific policies and regulations
Recommendations for addressing the challenges	• Translate complex legal language into simple, farmer-friendly terms. Where possible, use local languages when necessary to ensure that policy documents are accessible and comprehensibly • Tailor training programs to the specific needs and literacy levels of different farmer groups. Address the unique requirements of women, youth, and marginalized communities. • Illustrate policy concepts with practical, real-world examples that resonate with farmers and demonstrate the impact of compliance on their daily practices.
Lessons learned	Effective training in dairy policies and regulations is fundamental in empowering farmers with the knowledge and tools needed to navigate the dynamic agricultural landscape, adhere to legal requirements, and make informed decisions that support the long-term success and economic well-being of their dairy enterprises.
Social, environmental, policy and market conditions necessary for development and upscaling	• Need for farmers awareness of the importance of compliance to policies and regulations • Have access to some level education and relevant resources, • Access and support by farmer-friendly policies. • Rewarding markets on compliance and create opportunities for farmers to benefit from their adherence to regulations. • Culturally sensitive training program and engagement with the local community to foster trust and cooperation
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	TFree
Estimated returns	Farmers will be empowered to operate in a legal, competitive and conducive environment for dairy business where operations will be within set guidelines, laws and regulations.
Gender issues and concerns in development, dissemination, adoption and scaling up	• Unequal access to training opportunities and resources • Unequal voice in policy discussions. • Differences in access to resources, decision-making power, and labor roles.

	• Time constraints faced by women due to household and care-giving responsibilities, and adapting training schedules and formats accordingly. • Cultural norms and beliefs may discourage women from participating in public activities or interacting with unfamiliar individuals, including trainers.
Gender related opportunities	• Understanding policy options can lead to a deeper appreciation of the economic implications of regulatory compliance, potentially creating new business and career paths for men, women and youth as trainers. • This knowledge can also empower them to navigate the regulatory landscape effectively and seize economic opportunities within the context of policy and regulation.
VMG issues and concerns in development, dissemination adoption and scaling up	• Financial constraints, limited transportation, or physical accessibility issues. • Training content not being culturally sensitive accommodating the customs, beliefs, and practices of different marginalized groups to ensure that the training is relevant and respectful. • VMGs especially women have unique needs and challenges, such as childcare and safety concerns. • Training programs not accommodating materials in accessible formats e.g. sign language interpreters, and physical facilities that are wheelchair-friendly. • VMGs have economic constraints that can prevent them from attending training programs, as they may not be able to afford travel costs or no wages • Geographic isolation especially for rural and remote communities • Stigmatization and discrimination can deter individuals from participating in training programs, • Lack of community support.
VMG related opportunities	• VMGs may gain awareness and a deeper understanding of relevant policies and regulations, which can help them make informed decisions about their activities and rights. • Training equips VMGs with the knowledge and skills needed to actively engage in policy advocacy, allowing them to voice their concerns and influence policy decisions that affect their well-being. • Understanding and complying with regulations can protect VMGs from legal issues and ensure their activities align with the law, reducing the risk of penalties or discrimination.

	• Compliance with regulations can open doors to markets and economic opportunities, enabling VMGs to sell products or services that meet legal requirements and access better income prospects. • VMGs can identify entrepreneurial opportunities in the compliance and regulatory space, offering services related to quality control, product certification, or compliance consulting
E: Case studies/profiles of success stories	
Success stories	New TIMP
Application guidelines for users	Technical bulletins are available
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling
G: Contacts	
Contacts	Director General Kenya Agricultural and Livestock Research Organization (KALRO) P.O Box, 57811-00200 Nairobi director@kalro.org
Lead organization and scientists	KALRO, Alice Murage, Ndungu Mathai, Esther Chelimo, Elkana Nyambati
Partner organizations	Ministry of Agriculture Livestock and Fisheries, Kenya

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