DRAFT

INVENTORY OF CLIMATE SMART AGRICULTURE DAIRY TECHNOLOGIES, INNOVATIONS & MANAGEMENT PRACTICES

Compiled by

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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 and practices (seeding rates, fertilizer application rates, spatial arrangements, planting period, land preparation, watering regimes, etc.), protection methods, for crops; and feed rations, management systems, disease control methods, etc. for animal breeds. This is therefore important information which is generated through research to accompany the parent technology before it is finally released to users and the technology would be incomplete without this information.

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

1.2 Summary of Inventory of TIMPs in the Dairy Value Chain

The inventory process resulted in a total of 23 TIMPs including 20 technologies, 0 innovations and 3 management practices, distributed among the 6 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	2	0	1
Dairy	Feeds and Feeding	12	0	0
Dairy	Feed formulation	2	0	0
Dairy	Crop residue and industrial by-products use	1	0	0
Dairy	Value addition	3	0	1
Dairy	Manure management for bioenergy	0	0	1
Overall Total		**20**	**0**	**3**

1.3 Summary of Status of TIMPs in Dairy Value Chain

The inventory process resulted in a total of 23 TIMPs that are ready for upscaling, 9 TIMPs that require validation and 2 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	3	1*	1*
Dairy	Feeds and feeding	12	3	0
Dairy	Feed formulation	2	0	0
Dairy	Crop residues	1	0	1*
Dairy	Milk value addition	4	0	0
Dairy	Manure management	1	0	0
Overall Total		**23**	**9**	**2**

*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	Technology	Ready for upscaling/Needs validation
	2.1.2 Improving indigenous cattle for dairy production through targeted selection and cross breeding	Management practice	Ready for upscaling/Further research
	2.1.3 Friesian Sahiwal Crossbreds	Technology	Ready for Upscaling
2.2 Feeds and feeding	2.2.1 Stunt and smut tolerant 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 and validation
	2.2.7 Desmodium (*Desmodium intortum*)- Napier grass intercrop	Technology	Ready for upscaling
	2.2.8 Tree lucerne or tagasaste- *Chamaecytisus prolifer*	Technology	Ready for upscaling and validation
	2.2.9 Sweet lupin (*Lupinus albus* and *Lupinus angustifolius*)	Technology	Ready for upscaling and validation
	2.2.10 Sweet potato vines	Technology	Ready for upscaling
	2.2.11 Cassava based Napier grass silage	Technology	Ready for upscaling
	2.2.12 Napier grass and gliricidia leaves silage	Technology	Ready for upscaling
2.3 Feed formulation	2.3.1 Feed rations formulation	Technology	Ready for upscaling
	2.3.2 Early calves' weaning diet as milk replacer	Technology	Ready for upscaling
2.4 Crop residue and Industrial By-products utilization	2.4.1 Crop residue based Total Mixed Total mixed ration (TMR)	Technology	Ready for upscaling/further research

TIMPs Sub-Theme	TIMPs Title	TIMPs Category	Status
2.5 Value addition	2.5.1 Milk value addition and marketing	Management practice	Ready for upscaling
	2.5.2 Cheese Production from dairy milk	Technology	Ready for upscaling
	2.5.3 Yoghurt production from dairy milk	Technology	Ready for upscaling
	2.5.4 Butter production from dairy milk	Technology	Ready for upscaling
2.6 Manure management for bioenergy	2.6.1 Domestic Biogas	Management practice	Ready for up scaling
*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 Value chain TIMPS

2.1 CATTLE BREEDING AND IMPROVEMENT

2.1.1 TIMP name	Assisted Reproductive Technique using Sahiwal germplasm
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	- Low dairy production potential of indigenous cattle - Inadequate germplasm of breeds with high milk yield potential, disease and heat tolerance - Low awareness of farmers and service providers on the productivity potential of the Sahiwal breed
What is it? (TIMP description)	Use of Assisted Reproductive Technique (ART) and cross breeding to upgrade indigenous cattle using Sahiwal germplasm. The animals are injected with hormones to induce ovulation followed by insemination. The advantages include: - Planned calving to coincide with feed availability - Timely breeding (synchronized ovulation, reduced repeat services) leading to a decrease in calving interval - Increased herd productivity - Increased productivity of the progeny (crossbreds)
Justification	- The Sahiwal is a dual-purpose breed adapted to dry areas where it produces about 5-15 L of milk compared to about a litre daily from indigenous cattle - Crossbred cows produce about 10 L daily - ART is likely to enhance the crossbreeding process to increase the number of crosses and increase milk production - Need to strengthen capacity of farmers and other stakeholders to improve and sustain dairy productivity through use of ART
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Agro-pastoral and pastoral communities interested in dairy production
Approaches to be used in dissemination	Training of Trainers (ToTs) and extension publications (leaflets, booklets, posters) Pastoral Field Schools, local FM radio stations, Farmer group training
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	i. Extension service providers (public and private) – to train farmers on ART and monitor implementation ii. Private artificial insemination service providers – timely provision of quality semen iii. KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation iv. University of Nairobi – technology development and fine tuning v. Kenya Livestock Breeders Association(KLBA) - maintain records of the up-grading scheme for crosses and issue registration certificates for the animals vi. 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, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	- Weak livestock recording and registration - Feed availability - Limited skills in ART - Inadequate extension publications
Suggestions for addressing the challenges	- Support for livestock recording and registration - Training in ART - Documentation of ART and knowledge sharing - Training on feed conservation
Lessons learned in upscaling if any	Need to dispel cultural myths like *AI calves are weaker than those sired by bulls*
Social, environmental, policy and market conditions necessary for development and upscaling	- Awareness and acceptance of ART (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	Hormones cost about KES 90 per cow
Estimated returns	Not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	- Low literacy for women yet they are expected to keep milk records - Because of the women's low literacy level there is need to capacity build them - AI is mainly carried out by men and the youth - Women have triple roles and have limited time for training

Gender related opportunities	Increased milk production hence improved household nutrition, increased income, increased involvement of women and youth in milk marketing therefore need to train women and youth on value addition on agri-business
VMG issues and concerns in development and dissemination	Milk is important for health and there is need to target VMGs for dissemination
VMG issues and concerns in adoption and scaling up	Target VMGs for ART upscaling activities and ensure their animals are included in scaling
VMG related opportunities	Increased milk production hence improved nutrition, increased income, increased involvement of VMGs in milk marketing, need to train them on value addition and agri-business skills
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Keyian group ranch in Trans Mara
Application guidelines for users	Refer to the ART protocol booklet in Naivasha
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling and validation
G: Contacts	
Contacts	Centre Director, KALRO Naivasha
Lead organization and scientists	Evans Ilatsia, Tobias Onyango, Tobias K'Oloo, John Nguru, Mathai Munyori, David Mbugua, KALRO
Partner organizations	University of Nairobi, Directorate of Veterinary Services, KLBA, KAGRC

Gaps

1. Unknown rate of adoption of ART in areas where it has been promoted
2. Use of locally available mineral boosters and indigenous knowledge
3. Field surveillance in participating village breeding schemes to monitor disease and husbandry management where bulls were used
4. Need to determine the economics of the ART breeding strategies
5. Develop appropriate nutritional programme for ART breeding stock.

2.1.2 TIMP name	Improving indigenous cattle for dairy production through targeted 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	- Low dairy production potential of indigenous cattle - Inadequate germplasm of breeds with high milk yield potential, disease and heat tolerance - Low awareness of farmers and service providers on the productivity potential of the Small East African Zebu breed

What is it? (TIMP description)	- Continuous selection and cross breeding to improve indigenous cattle using Sahiwal germplasm. - For increased herd productivity - Increased productivity of the progeny (crossbreds)
Justification	- The Sahiwal is a dual-purpose breed adapted to dry areas where it produces about 5-15 L of milk compared to about a litre daily from indigenous cattle - Crossbred cows produce about 10 L daily - The bull calves grow fast and reach maturity early for the slaughter, supplementing the family source of income.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Agro-pastoral and pastoral communities interested in dairy production
Approaches to be used in dissemination	Training of Trainers (ToTs) and extension publications (leaflets, booklets, posters) Pastoral Field Schools, local FM radio stations, Farmer group training
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	i. Extension service providers (public and private) – to train farmers and advice on benefits of cross breeding. ii. Private artificial insemination service providers – timely provision of quality semen iii. KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation iv. Kenya Livestock Breeders Association(KLBA) - maintain records of the up-grading scheme for crosses and issue registration certificates for the animals v. 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, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	- Weak livestock recording and registration - Feed availability - Inadequate extension materials
Suggestions for addressing the challenges	- Support for livestock recording and registration - Training in crossbreeding

	- Documentation of crossbreeding and knowledge sharing - Training on feed conservation
Lessons learned in upscaling if any	Need to dispel cultural myths like *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 zebu like the indigenous cattle) - Manure use to improve pastures - Good milk market and value addition to cater for increased production
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	AI cost or improved breeding bull and associated cost
Estimated returns	Weaning weight increased from 108 to 170 Kg. Increased milk production of milk produced (about 3-6lts/day) by the crossbreed under grazing with minimal supplementation
Gender issues and concerns in development, dissemination, adoption and scaling up	- Low literacy for women in dry area yet they are expected to keep milk records - Because of the women's low literacy level there is need to capacity build them - AI is mainly carried out by men and the youth
Gender related opportunities	Increased milk production hence improved household nutrition, increased income, increased involvement of women and youth in milk marketing therefore need to train women and youth on value addition on agri-business
VMG issues and concerns in development and dissemination	Milk is important for health and there is need to target VMGs for dissemination
VMG issues and concerns in adoption and scaling up	Target VMGs for cross breeding activities and ensure their animals are included in scaling
VMG related opportunities	Increased milk production hence improved nutrition, increased income, increased involvement of VMGs in milk marketing, need to train them on value addition and agri-business skills
E: Case studies/profiles of success stories	
Success stories from previous similar projects	An apparent change of the indigenous to Sahiwal crosses (brown coat colour) in Narok and Kajiado counties
Application guidelines for users	Refer to the ART 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	Centre Director, KALRO Naivasha
Lead organization and scientists	Evans Ilatsia, Tobias Onyango, Tobias K'Oloo, John Nguru, Mathai Munyori, David Mbugua, KALRO

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.

2.1.3 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	- Low dairy production potential of indigenous cattle - Inadequate germplasm of breeds with high milk yield potential, disease and heat tolerance - Low awareness of farmers and service providers on the productivity potential of the Sahiwal breed - Low adaptability of the Friesian under climate change particularly in the ASALs
What is it? (TIMP description)	Use of cross breeds to improve productivity. The advantages 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)
Justification	- The Sahiwal is a dual-purpose breed adapted to dry areas where it produces about 5-15 L of milk compared to about a litre daily from indigenous cattle - Crossbred cows produce about 10 L daily - Need to strengthen capacity of farmers and other stakeholders to improve and sustain dairy germplasm
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	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) and extension publications (leaflets, booklets, posters) Pastoral Field Schools, Farmer group training
Critical/essential factors for successful promotion	i. Functional regional Centres for sustainable supply of quality semen ii. Proper maintenance of records of parents (sire and dam) to avoid inbreeding iii. Performance recording and registration of the offspring in the farms iv. Year-round availability of quality feeds
Partners/stakeholders for scaling up and their roles	i. Extension service providers link up the farmers with the source of breeding animals and monitor implementation

	ii. Private artificial insemination service providers – timely provision of quality semen iii. KALRO – technology development and fine tuning, ToT, backstopping and monitor implementation iv. Kenya Livestock Breeders Association(KLBA) - maintain records of the up-grading scheme for crosses and issue registration certificates for the animals v. Kenya Animal Genetic Resources Centre (KAGRC) – collect semen of selected Sahiwal Friesian cross bred 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, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	- Weak livestock recording and registration - Feed availability - Limited knowledge on the existence of the Sahiwal Friesian cross breeds - Inadequate extension publications
Suggestions for addressing the challenges	- Support for livestock recording and registration - Training in cross breeding - Documentation of the Sahiwal Friesian Crosses and knowledge sharing - Training on feed conservation
Lessons learned in upscaling if any	Need to dispel cultural myths like *AI calves are weaker than those sired by bulls*
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	Cost AI and breeding bulls
Estimated returns	Not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	- Because of the women's low literacy level there is need to capacity build them - AI is mainly carried out by men and the youth - Women have triple roles and have limited time for training
Gender related opportunities	Increased milk production hence improved household nutrition, increased income, increased involvement of women and youth in milk marketing therefore need to train women and youth on value addition on agri-business

VMG issues and concerns in development and dissemination	Milk is important for health and there is need to target VMGs for dissemination
VMG issues and concerns in adoption and scaling up	Target VMGs for crossbreeds and upscaling activities to ensure their animals are included in scaling
VMG related opportunities	Increased milk production hence improved nutrition, increased income, increased involvement of VMGs in milk marketing, need to train them on value addition and agri-business skills
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Keyian group ranch in Trans Mara
Application guidelines for users	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	Centre Director, KALRO Naivasha
Lead organization and scientists	Evans Ilatsia, Tobias Onyango, Tobias K'Oloo, John Nguru, Mathai Munyori, David Mbugua, KALRO
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

2.2 FEEDS AND FEEDING

2.2.1 TIMP name	Stunt and smut tolerant Napier grass varieties (Kakamega 1, 2, and 3; Ouma; South Africa)
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Dairy feed unavailability due to disease challenges
What is it? (TIMP description)	- This technology includes conventional varieties and those tolerant to stunting and head smut (Kak1/2/3, Ouma, and South Africa) - The grasses are perennial and are mainly used for cut-and carry for year-round feeding, silage making and hedgerow in soil conservation - Produces 75% of DM of Bana grass the conventional fodder which is susceptible to stunt and smut
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 resulting to low productivity
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers
Approaches used in dissemination	Field days and demonstrations, farmer group training e.g. Farmer field schools, agricultural shows and farmer to farmer visits
Critical/essential factors for successful promotion	- Availability of adequate clean planting materials - Attractive markets for dairy products
Partners/stakeholders for scaling up and their roles	KALRO –multiplication of planting material, ToT, backstopping and monitor implementation Extension service providers (public and private) – train farmers Farmer groups – provide and manage demonstration plots
C: Current situation and future scaling up	
Counties where already promoted if any	KALRO Muguga (highlands) and KALRO Katumani (lowlands)
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Inadequate clean planting materials
Recommendations for addressing the challenges	- Use of biotechnology such as tissue culture for mass production - Decentralize planting materials from KALRO centres
Lessons learned if any	
Social, environmental, policy and market conditions necessary for development upscaling	i. Community awareness of the varieties' benefits and their willingness to adopt them ii. Adaptability of the varieties to prevailing local conditions iii. Availability of adequate disease-free planting materials iv. Controlled movement of planting materials v. Good milk markets to cater for anticipated yield increase
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not established
Estimated returns	Not established
Gender issues and concerns in development, dissemination, adoption and scaling up	Manuring and maintenance tasks are mainly carried out by women while harvesting and processing is done mainly by men
Gender related opportunities	Availability of forage has potential of increasing milk production, generating wealth from milk and benefiting men, women and youth
VMG issues and concerns in development and dissemination	Ease of access to clean planting material by targeting VMGs farms for demos on stunt and smut tolerant varieties
VMG issues and concerns in adoption and scaling up	Target VMGs participation in adoption and scaling up activities

VMG related opportunities	- Livelihood improvement through increased milk consumption and sales resulting from use of clean planting materials and increased feeds - Business opportunity to grow smut and stunt tolerant varieties for sale to dairy farmers
E: Case studies/profiles of success stories	
Success storiesfrom previous similar projects	This technology has been shared with other EAC countries
Application guidelines for users	Leaflets on stunt and smut tolerant varieties available in KALRO
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
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	Masinde Muliro University of Science and Technology, International Centre for Insect Physiology and Ecology (ICIPE), National Livestock Resources Research Institute (NALIRRI), Uganda

GAP:

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

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 addressed	Low quality feeds in frost prone areas
What is it? (TIMP description)	- Oats harvested at the milk or early dough stages make excellent hay - Proper curing at this stage will make palatable and highly nutritious hay
Justification	- Oats is a versatile, succulent, fast growing, highly palatable and nutritious cereal acceptable to all types of livestock - Need to sensitize farmers on use of oats hay for dairy feeding - Utilization of oats hay, will increase milk yield in frost prone areas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small scale dairy farmers
Approaches used in dissemination	Field days, posters, brochures, pamphlets

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
Partners/stakeholders for scaling up and their roles	i. KALRO –ToT, backstopping and monitor implementation ii. Extension service providers (public and private) – to train farmers on use of oat hay ii. Oat seed growers – to provide certified seed to farmers
C: Current situation and future scaling up	
Counties where already promoted if any	
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	
Suggestions for addressing the challenges	Encourage utilization of oats as animal feed
Lessons learned	An attractive milk market for small scale farmers
Social, environmental, policy and market conditions necessary	i. Encourage farmers to use oats planting materials ii. Need for favourable milk markets
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not determined
Estimated returns	Not determined
Gender issues and concerns in development, dissemination, adoption and scaling up	None
Gender issues and concerns in adoption and scaling up	The technology is gender friendly and can be adopted and scaled up to all
Gender related opportunities	Availability of forage has potential for increasing milk production, generating wealth from milk and benefiting men, women and youth
VMG issues and concerns in development and dissemination	Access to enough land for forage production and availability of milk markets
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of hay.
E: Case studies/profiles of success stories	
Success stories from previous similar projects	
Application guidelines for users	Pamphlets
F: Status of TIMP readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling

G: Contacts	
Contacts	Centre Director, KALRO Ol Joro Orok,
Lead organization and scientists	KALRO N.N. Kanegeni, E. Nyambati, N. Mathai, David Mbugua, Dr. J. Muia
Partner organizations	MoALF&I, County governments

Gaps

i. Validation of oat legume mixture in different agro-ecological zones

ii. Validation of Oat based feeding regimes

iii. Economic analysis of Oat based fodder

iv. Economics of milk production from Oat based fodder feeding.

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 addressed	Low quantity of feeds and frost challenges in maize in high altitude/cold areas
What is it? (TIMP description)	Early maturing maize variety suitable for the cold highlands. Appropriate for silage making because of high biomass
Justification	There is serious inadequate fodder for silage making and green chops in the humid highlands that are characterized by low temperatures and occasional frost
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers in high altitude areas
Approaches used in dissemination	Field days, posters, brochures, pamphlets
Critical/essential factors for successful promotion	Availability of seeds
Partners/stakeholders for scaling upand their roles	KALRO, MoALF&I in sensitizing and mobilization of dairy farmers
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nakuru, Laikipia and Elgeyo Marakwet
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Nyandarua, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Limited information on the technology
Recommendations for addressing the challenges	i. Sensitization and training of farmers ii. Improving seed access
Lessons learned	i. The crop is a multi-purpose used as food and feed for livestock ii. Grain or bran can be used for feed formulation

Social, environmental, policy and market conditions necessary	i. Encourage farmers to use clean maize seed ii. Good milk prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 45,000 per acre to produce fodder
Estimated returns	15 to 20 tons per acre depending on crop husbandry though cost benefit analysis has not been done
Gender issues and concerns in development, dissemination, adoption and scaling up	None
Gender related opportunities	Availability of forage and grain has potential of increasing milk production, generating wealth from milk and benefiting men, women and youth
VMG issues and concerns in development and dissemination	Access to sufficient land space for maize production and good milk prices
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from forage and grain sale
E: Case studies/profiles of success stories	
Success stories from previous similar projects	Dairy farmers and cooperatives in Nyandarua have successfully made silage from this HAC variety that has successfully impacted their dairy enterprises
Application guidelines for users	Farmer booklet
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
Lead organization and scientists	KALRO; N.N. Kanegeni, Dr. E. Nyambati, Dr. J. Muia N. Mathai, D. Mbugua, Ligeyo
Partner organizations	KALRO Ol Joro Orok, KALRO Kitale, MoALF&I

Gaps

i. Validation of HAC maize fodder in different agro-ecological zones

ii. Validation of HAC maize fodder-based feeding regimes

iii. Economic analysis of HAC maize fodder for green chop or silage

iv. Economics of milk production from HAC maize fodder for green chop or silage feeding.

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 addressed	Low quantity of feeds due todrought challenges
What is it? (TIMP description)	High yielding, drought resistant fodder crop for silage making
Justification	This is an alternative forage for use in dairy cattle feeding and is drought tolerant, hence suitable formarginal areas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers especially those who make silage
Approaches used in dissemination	Field days, posters, brochures, pamphlets, demonstrations
Critical/essential factors for successful promotion	Availability of seeds
Partners/stakeholders for scaling up and their roles	KALRO, MoALF&I, Counties with dairy VC
C: Current situation and future scaling up	
Counties where already promoted if any	
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Limited information on the technology
Suggestions for addressing the challenges	i. Sensitization and training of farmers ii. Improving seed access
Lessons learned	i. Bulking can improve seed availability ii. Good regrowth after cutting
Social, environmental, policy and market conditions necessary	i. Encourage farmers to use clean seed ii. Good milk prices
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	All household members can effectively participate in adoption and scaling up
Gender related opportunities	Availability of forage and seed has potential of increasing milk production, generating wealth from milk and benefiting men, women and youth
VMG issues and concerns in development and dissemination	Access to clean seed for planting. Targeting VMGs farms for demos on suitable varieties
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of silage and seed
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 successfully impacted their dairy enterprises
Application guidelines for users	Farmer booklet
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, Lanet
Lead organization and scientists	N.N. Kanegeni, E. Nyambati, N. Mathai, J. Muia, D. Mbugua, I. Tura and J. Ouda KALRO Ol Joro Orok
Partner organizations	KALRO Ol Joro Orok, KALRO Lanet, MoALF&I

Gaps

i. Validation of fodder sorghum in different agro-ecological zones

ii. Validation of fodder sorghum-based feeding regimes

iii. Economic analysis of Sorghum-based silage feeding

iv. Economics of milk production from Sorghum-based silage.

2.2.5 TIMP name	**Climate smart Brachiaria grass**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The rising interest in livestock development fueled by increased demands of animal products which has led to the demand for productive and high-quality forages to bridge livestock feed deficit. It is an alternative fodder to Napier grass susceptible to head smut and stunting disease
What is it? (TIMP description)	The 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. The grass can be used as cut-and-carry, grazed or conserved as hay or silage. The grass can produce 6-12 t/ha DM per year. It is palatable and nutritious with CP of up to 16%.
Justification	Brachiaria grasses a native of eastern Africa have been widely adapted as livestock feed in south America and East Asia. 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 and smallholder dairy farmers
Approaches used in dissemination	Training of users of the technology, demonstrations, dairy smart model farms, field day, demonstrations
Most effective approach	Training of users of the technology and dairy smart model farms
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	County government extension service providers, farmers groups and CBOs, farmers, Agricultural training centres and KALRO
C: Current situation and future scaling up	
Counties where already promoted if any	The grass grows well in areas with more than 700 mm annual mean rainfall, and where temperature exceeds 19^{o}C. The technology has been tested and used in the following regions: the coastal lowlands, eastern, central and western Kenya highlands
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Lack Brachiaria grass seed Small farm sizes
Recommendations for addressing the challenges	Use of Brachiaria root splits and cane cuttings as planting material
Lessons learned	i. Farmer demand for the planting materials is high ii. Does well in fertile soils ii. 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	- Include women, men and youth in capacity building - Embrace good agricultural practices (GAP) to reduce GHG, soil nutrient losses - Organized markets with favourable pricing policy to encouraging producers
D: **Economic, gender, vulnerable and marginalized groups (VMGs) considerations**	
Basic costs	Establishment costs are like in other grasses
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	Women and youth are encouraged to participate in development and dissemination of this technology since they are the first line users
Gender related opportunities	Increased income as a result of increased milk sales

VMG issues and concerns in development and dissemination	VMGs are encouraged to participate in development and dissemination of this technology
VMG issues and concerns in adoption and scaling up	VMGs should adopt and scale up the Brachiaria technology
VMG related opportunities	Commercial production of Brachiaria seeds and /or splits
E: Case studies/profiles of success stories	
Success stories	The technology has been successfully used by dairy groups in Kieni, Nyeri
Application guidelines for users	Farmer leaflets and production manuals
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for Upscaling
G: Contacts	
Contacts	KALRO Katumani, Ol Joro Orok, Lanet and Naivasha
Lead organization and scientists	KALRO Katumani and Naivasha Donald Njarui, E. Nyambati, N. Kanegeni, N. Odabu and W. Ayako
Partner organizations	Becca ILRI, County Governments

Gaps:

(i) Need to identify niches for Brachiaria seed production

(ii) Need for Brachiaria NPT for seed certification and commercial release

(iii) Research on identification of newer varieties, carrying capacity, persistence under cut and carry and grazing regimes

(iv) Validation on the Brachiaria-based feeding regimes for dairy cattle

(v) Economic analysis of Brachiaria grass production

(vi) Economics of milk production from Brachiaria based feeding regimes.

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 addressed	Inadequate quality of feeds particularly lack of protein in 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. - 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.
Justification	- Common vetch has high crude protein of above 19% and is highly acceptable as grazed or conserved forage - It is persistent and a prolific seeder withstanding competition from grasses
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	- Small scale dairy farmers - Seed producers
Approaches used in dissemination	Field days, posters, brochures, pamphlets
Most effective approach	Field days
Critical/essential factors for successful promotion	An attractive milk market for small scale farmers
Partners/stakeholders for scaling up and their roles	Co-operatives, MoALF&I, Self-help groups
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Vetch seed unavailability
Recommendations for addressing the challenges	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	An attractive milk market for small scale farmers
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Establishment costs is around KES 20,000 per acre
Estimated returns	About 100 to 150 bales of vetch hay in a pure stand
Gender issues and concerns in development, dissemination, adoption and scaling up	Men, women and the youth can effectively participate in adoption and scaling up
Gender related opportunities	Availability of forage and seed has potential of increasing milk production, generating wealth from milk and benefiting men, women and youth
VMG issues and concerns in development and dissemination	Access to clean seed for planting and good milk prices
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of silage and seed.

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	Refer to farmer pamphlets and guidelines
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling and need validation
G: Contacts	
Contacts	Centre Director KALRO Ol Joro Orok and Naivasha
Lead organization and scientists	KALRO Ol Joro Orok N.N Kanegeni, E. Nyambati, J. Muia, N. Mathai, D. Mbugua and N. Ondabu
Partner organizations	MoALF&I, KEPHIS

Gaps:

(i) Need for NPT for Common vetch *(Vicia sativa)* seed certification and commercial release

(ii) Further research required for intercropping with fodder grasses

(iii) Validate the inclusion and substitution levels

(iv) Economic analysis of common vetch forage and seed production

(v) Economics of milk production from Vetch based feeding regimes.

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 quality feeds
What is it? (TIMP description)	Protein rich Desmodium is intercropped with Napier grass to improve the nutritive value of the Napier fodder, therefore increase milk production
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 with Napier grass alone

B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers
Approaches used in dissemination	Field days and shows
Most effective approach	Field days
Critical/essential factors for successful promotion	Availability of clean planting material
Partners/stakeholders for scaling up and their roles	KALRO, Ministry of Agriculture and Irrigation, Cooperatives and farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	This has been promoted widely with different levels of success. Some of the Counties where it has been promoted include Trans Nzoia, Nakuru, Nyandarua, Kiambu, Kakamega, Kisii, Muranga and Nyeri
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Labour intense technology especially at establishment
Recommendations for addressing the challenges	Access to planting materials especially Disodium seeds
Lessons learned	Increases yields and quality of fodder
Social, environmental, policy and market conditions necessary	Weed control and improved water retention. Desmodium can smoother the weeds growing in between Napier grass rows
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	Men, women and the youth can effectively participate in adoption and scaling up None
Gender related opportunities	Due to the smothering ability of weeds by Desmodium, it reduces the labour requirements especially to women.
VMG issues and concerns in development and dissemination	Access to clean planting material and seed
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of Napier canes and desmodium vines.
E: Case studies/profiles of success stories	
Success stories	Githunguri Dairy farmers (Mihuko and Thakwa high breeders), Bahati farmers (Mwangaza, Ariithi and Ngecha)
Application guidelines for users	Technical bulletin and farmer leaflets
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 Naivasha, Centre Director, KALRO Ol Joro Orok
Lead organization and scientists	Centre Directors, KALRO Naivasha, Ol Joro Orok, Muguga and Kitale N. Kanegeni, W. Ayako, I. Kariuki, N. Mathai, D. Mbugua, W. Ego and E. Nyambati.
Partner organizations	KALRO Naivasha, KALRO Ol Joro Orok, Ministry of Agriculture and Irrigation

Gaps:

(i) Need for research on cutting frequency and persistence of Napier Desmodium intercrop

(ii) Economic analysis of Desmodium forage and seed production

(iii) Economics of milk production from Desmodium based feeding regimes.

2.2.8 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 quality feeds
What is it? (TIMP description)	This is a perennial legume shrub rich in crude protein that grows in medium warm altitudes and cold highlands (1500 – 2500 m masl with600 -1600 mm of rain annually
Justification	It is a nitrogen fixing plant and has leaves havehigh protein content, used both as a fodder and a hedge
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers
Approaches used in dissemination	Field days and demonstrations
Most effective approach	Demonstrations
Critical/essential factors for successful promotion	Availability of tree Lucerne seeds and seedlings
Partners/stakeholders for scaling up and their roles	KALRO, MoALF&I and farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nakuru and Laikipia
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Low level of awareness, lack of seed
Lessons learned	Bulking of seed through farmer groups to increase access to seed
Social, environmental, policy and market conditions necessary	Tree Lucerne manages soil erosion and acts as a windbreak

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	They are used as a source of firewood and hence reduces labour for women It is also a very good bee forage, therefore a source of income through sale of honey which benefits the whole household
Gender related opportunities	An opportunity for women to sell seed and herbage to livestock farmers
VMG issues and concerns in development and dissemination	Access to clean planting material and seed
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of tree Lucerne seeds and seedlings
E: Case studies/profiles of success stories	
Success stories	Ikinyukia Self Help group involved in seed bulking and sales
Application guidelines for users	Farmer pamphlets and leaflets
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling ; requires NPT
G: Contacts	
Contacts	KALRO Ol Joro Orok
Lead organization and scientists	KALRO Ol Joro Orok, N.N. Kanegeni, E. Nyambati, T. Onyango, J. Muia, N Mathai and D. Mbugua
Partner organizations	KALRO, Ministry of Agriculture and Irrigation, Farmer groups

Gap:

(i) Need for NPT for Tree lucerne or tagasaste seed certification and commercial release

(ii) Validate harvesting management for leaves and twigs

(iii) Validate the inclusion and substitution levels in dairy rations

(iv) Economic analysis of fodder tree forage lucerne and seed production

(v) Economics of milk production from fodder tree lucerne based feeding regimes.

2.2.9 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 leading to low milk production

What is it? (TIMP description)	Lupins are legumes whose grains are rich in crude protein and is an ingredient in animal feeds formulations and the stubble is ploughed back to increase soil fertility. It is excellent in crop rotation with grasses and cereal crops.
Justification	Use of lupin/maize meal will reduce the cost of dairy supplementation and increase milk production
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Dairy farmers
Approaches used in dissemination	Field days and demonstrations
Most effective approach	Field days
Critical/essential factors for successful promotion	Availability of lupin seed and processing skills.
Partners/stakeholders for scaling up and their roles	KALRO, MoALF&I, Farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Trans Nzoia, Elgeyo Marakwet
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Low farmer awareness of on lupin potential as concentrate feed and unavailability of seed
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 lupin potential for the success of the technology
Social, environmental, policy and market conditions necessary	The crop fixes nitrogen and helps in management of soil erosion. Lupin crop also helps in crop rotation and fallowing
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	Acts as a cover crop aiding in soil erosion management and reduces number of weeding which is mainly done by women
Gender related opportunities	Seed harvesting for sale to livestock farmers
VMG issues and concerns in development and dissemination	Access to lupin seed
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of lupin seed
E: Case studies/profiles of success stories	
Success stories	

Application guidelines for users	Lupin seed meal and maize meal mixed in a ratio of 1:3, will form a concentrate with 17.1% CP. Note: Higher concentrations of the lupin are not recommended as more than 30% of lupin in the diet could cause metabolic upsets
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling, validation through NPT
G: Contacts	
Contacts	Centre Director , KALRO Ol Joro Orok
Lead organization and scientists	KALRO Ol Joro Orok, N.N. Kanegeni, E Nyambati, T Onyango and J Muia
Partner organizations	KALRO and MoALF&I

Gaps

(i) Need for validation of new sweet lupin *(Lupinus albus and Lupinus angustifolius)* varieties for feed rations

(ii) Need for sweet lupin NPT for seed certification and commercial release

(iii) Economic analysis of Lupin grain and seed production

(iv) Economics of milk production from Lupin grain-based feeding regimes.

2.2.10 TIMP name	**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)	Fodder sweet potato vines (SPV) are creepers legumes that have edible tubers which form the roots and its feed reserve. They are easily established and rich in crude proteins, hence very good supplemental fodder for dairy cattle on grasses and maize silage.
Justification	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
Approaches used in dissemination	Field days and demonstrations
Most effective approach	Field days, demonstrations, training, pamphlets
Critical/essential factors for successful promotion	Bulking and availing of fodder SPV planting vines.

Partners/stakeholders for scaling up and their roles	KALRO, MoAL&F, Farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Trans Nzoia, Kiambu, Elgeyo Marakwet, Uasin Gishu
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Low farmer awareness of fodder SPV potential as supplemental fodder to grasses. Lack of SPV planting materials
Recommendations for addressing the challenges	Training and availability of planting SPV to the farming communities.
Lessons learned	There is need to supply enough seed and sensitize farmers on SPV potential as supplemental fodder to grasses and maize/sorghum silages
Social, environmental, policy and market conditions necessary	SPV is a cover fodder crop that does not require weeding after establishment. It is perennial and vines can be harvested for a long time so long as the tubers are not uprooted.
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	About KES 30,000 for initial establishment per acre
Estimated returns	Not done
Gender issues and concerns in development, dissemination, adoption and scaling up	Acts as a cover crop aiding in soil erosion management and reduces number of weeding which is mainly done by women. Good source of minerals and vitamins when used as human food
Gender related opportunities	Increased milk production improving income and livelihoods
VMG issues and concerns in development and dissemination	Access to fodder SPV varieties for planting
VMG issues and concerns in adoption and scaling up	VMGs can effectively participate in adoption and scaling up
VMG related opportunities	Livelihood improvement from sale of milk
E: Case studies/profiles of success stories	
Success stories	Many farmers have sourced SPV for planting from KALRO
Application guidelines for users	A guide booklet is available in KALRO
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling
G: Contacts	
Contacts	Centre Directors , KALRO Ol Joro Orok, Lanet, Kakamega and Kitale

Lead organization and scientists	KALRO Ol Joro Orok N.N. Kanegeni, J. Munyasia, E. Nyambati, J Muia, W. Ayako, N Mathai, D. Mbugua, W. Ego
Partner organizations	KALRO and MoALF&I

Gaps:

(i) Validate the inclusion and substitution levels of Sweet potato vines in dairy diets

(ii) Economic analysis of Sweet potato vines forage

(iii) Economics of milk production from Sweet potato vines-based feeding regimes.

2.2.11 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
What is it? (TIMP description)	- This is a basal diet conserved towards the end of the wet season for use during the dry season when forage production is low; a mixture 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 - Can be ensiled in a pit or small airtight container/bag - 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
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 - Milk production is therefore low in the dry season due to inadequate and low-quality forages - Preservation of surplus forage has the potential for increasing or stabilizing milk production - The cassava-based silage is an option for providing high quality feed for the dry season - The 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 cassava-based silage 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

Approaches used in dissemination	Field days, farmer group training e.g. Farmer field schools, agricultural shows and farmer to farmer visits
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 –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 and Kwale
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
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 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 never experienced devastating effects of drought and they sustained milk production
Social, environmental, policy and market conditions necessary	- Reliable markets and stable milk prices - 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	Calculate from appropriate price of milk in the County Using the above costs, a cow should produce a minimum of 5 – 10 L daily sold at KES 30 to break-even for pit and bag silage respectively
Gender issues and concerns in development and dissemination	Use of a 200-litre drum of water recommended to compact material to avoid drudgery; option to ensile in small heavy duty re-cycled bags or other airtight containers makes it friendly for women who can make small quantities to fit in their daily chores
Gender issues and concerns in adoption and scaling up	Chopping and compacting of materials for ensiling requires mechanization especially as the quantities increase to reduce drudgery
Gender related opportunities	Youth and women can conserve the feed and sell to dairy farmers

	Provides an opportunity for division of labour where the youth dig the pit, women prepare cassava leaves and tubers and men harvest forages, chop and compact the mixture
VMG issues and concerns in development and dissemination	The VMG can use and sell cassava-based Napier grass silage for financial gains especially silage in 30 kg packages enough for one cow daily; target them during dissemination; demos can be held on their farms
VMG issues and concerns in adoption and scaling up	Target VMGs during up scaling by carrying out demos on their farms
VMG related opportunities	VMGs with no dairy cows can conserve silage in bags for sale to dairy farmers
E: Case studies/profiles of success stories	
Success stories	1. The impact of using the cassava-based Napier grass silage was narrated by Mama Grace Baya, a widow from Kakuyuni, Malindi with four children who maintains a Friesian crossbred cow. She fed cassava-based Napier grass silage during the January-March 2014 dry season had this to say: *"My cow was producing 13 litres but it is now giving me 20 litres a day after feeding the cassava-based Napier grass silage. My daily income has improved from KES 520 to 800 (market price of milk was KES 40 per litre). I can afford household requirement for food and pay fees for my two school going children. When I run short of money, I do not fear taking credit from the shopkeeper since I am confident of getting money when I sell my milk".* Mama Nyevu Kitsao Thoya, also a farmer from Malindi keeps a crossbred dairy cow who was a beneficiary of the on-farm cassava-based Napier grass silage training had this to say: *"Before I started feeding silage, my cow was producing four litres of milk per day, but it is now producing 10 litres. My cow likes the silage so much and eats it very well. When I give the silage overnight, by morning, the udder is full and I am able to extract enough milk unlike before".* *2.* Marieta Gona improved milk production from 6 to 10 litres in the introductory stage where she had done one silage pit. In the subsequent season, she made five silage pits, and this is what she said about her dairy enterprise: *"I have been able to improve milk production from 12 to 20 litres per day and at the peak of dry season, while my neighbours stopped milking their cows due to lack of feed, I sustained milk yield frommy cow at 18 litres. When my neighbour's farm workers absconded duty because of being assigned impossible work of looking for non-existent forage, I comfortably opened the silo to feed my cows. At the local milk collection Centre, daily collection declined from 300 litres to 30 litres a day and out of the 30 litres, 20 litres was my contribution. The improved milk yield has attracted the attention of milk processors such as Brookside who are now helping us with marketing our milk."*
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
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; Kadenge Lewa; H. Mkuzi Saha, L. Mambo
Partner organizations	Pwani University, CBOs, DLPOs (Kwale, Kilifi and Malindi), Heifer Project International (HPI)

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.

2.2.12 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 availability and low milk yield during the dry season
What is it? (TIMP description)	- This is a basal diet conserved towards the end of the wet season for use during the dry season when forage production is low; a mixture of wilted chopped Napier grass: wilted gliricidia forage: maize bran: in the ratio of 70:25:5. - Gliricidia forage can be substituted by other forage legumes The mixture is fermented under anaerobic conditions for at least six weeks - Can be ensiled in a pit or small airtight container/bag - 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
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 - Milk production is therefore low in the dry season due to inadequate and low-quality forages - Preservation of surplus forage has the potential for increasing or stabilizing milk production - The Napier grass and gliricidia-based silage is an option for providing high quality feed during the dry season - The technology is based on use of maize bran to replace molasses which is not readily available - The Napier grass, gliricidia, maize bran silage 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	Dairy farmers
Approaches used in dissemination	Field days, farmer group training e.g. Farmer field schools, agricultural shows and farmer to farmer visits
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 and Kwale
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
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 never experienced devastating effects of drought and they sustained milk production
Social, environmental, policy and market conditions necessary	- Reliable markets and stable milk prices - 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 (30kg for 1 cow per day); approx. weight of cow: 400kg
Estimated returns	Calculate from appropriate price of milk in the County Using the above costs, a cow should produce a minimum of 5 – 10 L daily sold at KES 30 to break-even for pit and bag silage respectively
Gender issues and concerns in development and dissemination	Use of a 200-litre drum of water recommended to compact material to avoid drudgery; option to ensile in small heavy duty re-cycled bags or other airtight containers makes it friendly for women who can make small quantities to fit in their daily chores
Gender issues and concerns in adoption and scaling up	Chopping and compacting of materials for ensiling requires mechanization especially as the quantities increase to reduce drudgery

Gender related opportunities	Youth and women can conserve the feed and sell to dairy farmers Provides an opportunity for division of labour where the youth dig the pit, women prepare gliricidia forage and men harvest forages, chop and compact the mixture
VMG issues and concerns in development and dissemination	The VMG can use and sell Napier grass, gliricidia and maize germ silage for financial gains especially silage in 30 kg packages enough for one cow daily; target them during dissemination; demos can be held on their farms
VMG issues and concerns in adoption and scaling up	Target VMGs during up scaling by carrying out demos on their farms
VMG related opportunities	VMGs with no dairy cows can conserve silage in bags for sale to dairy farmers
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 in 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 MoALF&I

Gaps:

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

2.3.FEED FORMULATION

2.3.1 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
What is it? (TIMP description)	This is based on a formula that derives possible dairy ration options for dairy production systems based on feed rations for dairy cows that maximize income over feed costs using locally available feed resources in farms for each County
Justification	Common feedstuffs in farms in most dairy counties are more available during the wet season and scarce during the dry season. The use of commercial concentrates and forage

	supplements is rare. The use of Dairy ration formulations using available feedstuffs on the farms will reduce the cost of production for farmers.
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small and medium scale dairy farmers
Approaches used in dissemination	Field days, farmer group training e.g. Farmer field schools, agricultural shows and farmer to farmer visits
Most effective approach	Field days and group training
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	Extension service providers (County, NGOs, Farmer Based Organizations, Faith based organizations), Farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	Counties with Dairy VC e.g. Bungoma and Siaya
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	- Inadequate skills in applying cost-effective ration formulation - Low awareness of the technology - Failure by the farmers to attend training sessions - ICT compliance by farmers
Recommendations for addressing the challenges	- Capacity building the Service providers who will train farmers on how to formulate rations for dairy cows - Interested stakeholders can access the technology from ICT platform
Lessons learned	Based on the information from the Counties of study, it is recommended that utilization of small farms should focus more on income generation besides food production
Social, environmental, policy and market conditions necessary	Farmers need to grow pastures and fodders with high dry matter yields and quality. This should include plant forages with high protein content in order to reduce on feed costs
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Calculated from price of milk sold at KES 30 to break-even Using the above costs, a cow should produce 7 – 12 L daily
Gender issues and concerns in development and dissemination	Women and youth to be involved in trainings to improve adoption of dairy production technologies including ration formulation to increase milk production at farm level
Gender issues and concerns in adoption and scaling up	- The technology is user-friendly for all gender - The availability of an ICT platform increases chances of technology access and adoption
Gender related opportunities	Youth and women can use the acquired knowledge of ration formulation to share out with other members of the community
VMG issues and concerns in development and dissemination	The VMG can use the acquired knowledge of ration formulation to share out with other members of the community

VMG issues and concerns in adoption and scaling up	-The technology is VMG friendly -The availability of an ICT platform increases chances of access and adoption
VMG related opportunities	VMG can use the acquired knowledge of ration formulation to share out with other members of the community at a cost
E: Case studies/profiles of success stories	
Success stories	Dairy farmers trained in Murang'a and Machakos Counties
Application guidelines for users	- Technical Manual for Dairy extension workers and farmers in Murang'a and Machakos Counties - Available in 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 Dairy Research Institute/Naivasha
Lead organization and scientists	KALRO J.M.K. Muia, I. Kariuki, N.N. Kanegeni, G. Gachuiri, P. Mbugua, R. Muinga and , J.N. Kariuki
Partner organizations	University of Nairobi, Murang'a and Machakos County livestock Officers

Gaps:

Feed formulation

(i) Test and validate suitable feed ration formulations based on locally available ingredients in selected dairy Counties

(ii) Economic analysis of feed ration formulation

(iii) Economics of feed formulated rations based on animal productivity.

2.3.2 TIMP name	**Early calves' weaning diet as milk replacer**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	- Address the economics of early calves' weaning diets on dairy-bull calves - Lack of information on the performance of dairy bull calves reared on different fortified complete-fodder-block formulae
What is it? (TIMP description)	This is based on feeding male calves born to dairy cows on diets equivalent to milk replacers offered from week 1 post-colostrum. The diets are fortified with effective microorganisms, diamond V and diatomite. The diets are offered with a basal diet of good quality Napier grass, Rhodes grass and *Leucaena.*

Justification	1. It is not cost effective economically to raise dairy bull calves on milk for farmers who do not wish to raise them 2. Existence of complete fodder block formulae makes efficient intake and utilization of early calf weaner diets by dairy bull calves
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small and medium scale dairy farmers
Approaches used in dissemination	On station demonstration
Most effective approach	Field days and group training
Critical/essential factors for successful promotion	1. Favourable milk prices and reliable markets 2. Capacity building of farmers interested in this technology
Partners/stakeholders for scaling up and their roles	Extension service providers (County, NGOs, FBOs), Farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	Counties with Dairy VC like Bungoma and Siaya
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in 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 fortified diets
Lessons learned	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	1. The technology will encourage farmers to raise dairy bull calves as opposed to eliminating them 2. 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 production reduced from USD 407 to 120
Estimated returns	The estimated returns (gross margin) increased from USD -63 to 520
Gender issues and concerns in development and dissemination	The technology provides an opportunity for Community-based bull-calf rearing and fattening/finishing as a viable agribusiness especially for the youths
Gender issues and concerns in adoption and scaling up	If the technology is embraced, the youth will scale it up reducing youth unemployment
Gender related opportunities	Economic gains shall be realized by the youth adopting the technology
VMG issues and concerns in development and dissemination	The VMG can use the acquired knowledge if resources are availed to them
VMG issues and concerns in adoption and scaling up	The adoption and scaling up of the technology by the VMG will depend on availability of resources to support the technology
VMG related opportunities	The technology creates economic opportunity for VMGs if adopted
E: Case studies/profiles of success stories	

Success stories	None
Application guidelines for users	Leaflet on Wean calves at 30 days (Syomiti M.) EAAPP documents
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for up scaling and further validation
G: Contacts	
Contacts	Centre Director, KALRO Muguga South
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 MoALF&I

Gaps

i. The technology needs to move out of the station to the stakeholders

ii. Determine the consistency and shelf life of the Essential Microorganism used in fortified Early calf Weaning Diets

iii. Validate, upscale and commercialize the diets on-farm

iv. Establish Community-based bull-calf rearing and fattening/finishing agribusiness units based on 'best-bet' technologies among the un-employed youths

2.4 Crop residue and Industrial by-products utilization

2.4.1 TIMP name	**Crop Residue based Total Mixed Ration (TMR)**
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 -
What is it? (TIMP description)	This is a nutritively balanced crop residue based total mixed ration feed block. Contains all major nutrients including proteins, energy and minerals for increased milk production. It has molasses to increase energy content and improve palatability and has urea to increase protein nitrogen.
Justification	- The crop residue based compacted total mixed ration is an innovative technology which could play an important role in feeding balanced rations to increase milk production. - The technology also has the potential to remove disparity in feed availability. - The technology has potential to be transported and stored easily
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
Approaches used in dissemination	Group training and demonstration
Critical/essential factors for successful promotion	1. Availability of compacting machine and molasses 2. Availability of forage chopper
Partners/stakeholders for scaling up and their roles	1. KALRO to train trainers, provide technical services 2. Extension service providers (County, NGOs, FBOs) to train farmer groups 3. *Jua kali* artisans to fabricate the machines
C: Current situation and future scaling up	
Counties where already promoted if any	Counties with Dairy VC like Kakamega, Elgeyo Marakwet and Trans Nzoia
Counties where TIMP will be upscaled	Counties with dairy and available crop residues and molasses. These will include Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	Availability and cost of the compacting machine
Recommendations for addressing the challenges	Engage and train *Jua kali* artisans to fabricate compacting machine using the developed prototype.
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, policy and market conditions necessary	Favourable price of feed ingredients and better market prices of milk
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated price of KES 15/- per kg and a dairy cow weighing 300 kg requires 2 blocks of 5 kg each
Estimated returns	Not done
Gender issues and concerns in development and dissemination	The technology provides an opportunity for Community-based women and youth groups to manufacture the TMR blocks and sell to fairy farmers during the dry season.
Gender issues and concerns in adoption and scaling up	If the technology is embraced, the youth will scale it up reducing youth unemployment
Gender related opportunities	Economic gains shall be realized by the women and youth groups who can
VMG issues and concerns in development and dissemination	The VMG can use the acquired knowledge if resources are availed to them particularly for the compacting machine
VMG issues and concerns in adoption and scaling up	The adoption and scaling up of the technology by the VMG will depend on availability of resources to support the technology
VMG related opportunities	The technology creates economic opportunity for VMGs if adopted
E: Case studies/profiles of success stories	

Success stories	None
Application guidelines for users	Technical training manual and farmer leaflet
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 Kakamega
Lead organization and scientists	KALRO Okitoi, L.; Munyasi, J.
Partner organizations	Sigalagala Technical College

Gaps:

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

2.5 VALUE ADDITION

2.5.1 TIMP name	**Milk value addition and marketing**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	Poor milk handling and marketing
What is it? (TIMP description)	Training and demonstration on milk value addition to organized farmer groups engaged in milk handling along the value chain
Justification	There are high post-harvest milk losses due to lack of knowledge by milk handlers
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Smallholder dairy farmers
Approaches used in dissemination	Demonstrations and training of farmer groups
Most effective approach	Demonstrations and training
Critical/essential factors for successful promotion	- Adequate milk production for processing - Good market for value added milk products - Appropriate training and demos on value addition
Partners/stakeholders for scaling up and their roles	Extension service providers (County, NGOs, Farmer Based Organizations, Faith based organizations), Farmer groups
C: Current situation and future scaling up	
Counties where already promoted if any	Tharaka Nithi and Uasin Gishu
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	- Poor milk markets - Inadequate number of trainers

	- Cost of value addition equipment Regulatory requirements - KEBS, KDB and Public health
Recommendations for addressing the challenges	- Capacity building of trainer who will train farmers on value addition - Avail market information - Provide subsidy on milk equipment - Organize farmers into groups that the regulatory authorities can work with
Lessons learned	In order to access markets and reduce transaction costs, there should be improvement on communication, electricity and roads infrastructure
Social, environmental, policy and market conditions necessary	- There should be adequate milk for value addition and marketing - The regulatory institutions should be more proactive in providing information on rules, regulations and standards
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Not done
Estimated returns	Not done
Gender issues and concerns in development and dissemination	- Men, women and the youth have different roles in production, value addition and marketing with respect to this technology - Women may have limited access to benefits though they handle most of the dairy activities
Gender issues and concerns in adoption and scaling up	Women and youth in should be empowered to enable them to use the acquired skills
Gender related opportunities	There are likely economic benefits for all gender through milk value addition
VMG issues and concerns in development and dissemination	The VMG can use the acquired knowledge of milk value addition
VMG issues and concerns in adoption and scaling up	The technology is VMG friendly
VMG related opportunities	VMG can use the acquired knowledge of milk value addition for economic gain
E: Case studies/profiles of success stories	
Success stories	Ciomburu and Muchege farmer groups in Tharaka Nithi and Uasin Gishu Counties respectively
Application guidelines for users	Standard procedures for milk value addition
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 Institute/Naivasha
Lead organization and scientists	KALRO S. Makokha, D. Kanegeni, P Alaru, N. Mathai and D. Mbugua

Partner organizations	- Ministry of Agriculture Livestock and Fisheries, Kenya - Kenya Agricultural and Livestock Research Organization (KALRO)

Gaps

Validate the value addition technologies in other counties

2.5.2 Technology name	**Cheese production from dairy milk**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low incomes from raw milk Milk waste especially during milk glut Shelf life issues
What is it? (TIMP description)	Cheese is a milk product obtained from milk solids or proteins known as casein by coagulation of milk, and whey expulsion done in the vat. The curd also undergoes cutting, pressing, molding and salting.
Justification	Better income Improve livelihoods from improved incomes Reduce wastage during milk glut
Region promoted	Nyandarua and other milk producing areas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small holder dairy farmers
Approaches used in dissemination	Demonstrations, practical training sessions, field days
Critical/essential factors for successful promotion	Appropriate equipment and ingredients for processing Availability of quality milk Attractive markets for value added dairy products
Partners/stakeholders for scaling up and their roles	Kenya Dairy Board, Public health, Cooperatives, Extension service providers, licensing authority, Self-help groups and County government
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nakuru and Laikipia
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	High cost of processing equipment Lack of local sources of some ingredients Milk adulteration Inadequate trainers Regulatory requirements by KEBS, KDB and Public health
Recommendations for addressing the challenges	Training, Capacity building of trainers, availability of appropriate processing equipment and Market information
Lessons learned	Ready market for value added products exist
Social, environmental, policy and market conditions necessary	Good milk market Appropriate training and demonstration sites Availability of extension services

D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	635 KES per kg
Estimated returns	1200 KES per kg
Gender issues and concerns in development and dissemination	Both gender can effectively participate in development and dissemination
Gender issues and concerns in adoption and scaling up	Both genders can effectively participate in adoption and scaling up.
Gender related opportunities	Improved livelihoods among the members of the society who will adopt this technology
VMG issues and concerns in development and dissemination	Improved livelihoods among the vulnerable members of the society who will adopt this technology
VMG issues and concerns in adoption and scaling up	Cost of processing equipment and lack of processing skills
VMG related opportunities	Improved incomes that enhance livelihoods
E: Case studies/profiles of success stories	
Success stories	-
Application guidelines for users	Pamphlets, farmer booklets and training manuals
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 and Naivasha
Lead organization and scientists	N.N Kanegeni, N. Mathai, P. Alaru and D. Mbugua
Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

Gaps:

1. Validation of different products, additive, flavours and colours to suit customer tastes and preferences
2. Lack of appropriate equipment for processing and cost saving for production

2.5.3 Technology name	Yoghurt production from dairy milk
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low incomes from raw milk Milk waste especially during milk glut Shelf life issues
What is it? (TIMP description)	Yoghurt is one of the fermented dairy milk that is thermophillic (fermented within optimum growth temperatures between 35-45^{o}C). Yogurt is made by culturing milk with a variety of lactic acid producing, thermophillic bacteria.

Justification	Better income, improve livelihoods and reduce wastage during milk glut
Region promoted	Nyandarua and other milk producing areas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small holder dairy farmers
Approaches used in dissemination	Demonstrations, practical hands on sessions, field days
Critical/essential factors for successful promotion	Availability of quality milk Attractive markets for dairy products Appropriate training Affordable equipment
Partners/stakeholders for scaling up and their roles	Kenya Dairy Board Cooperatives Extension service providers Self-help groups
C: Current situation and future scaling up	
Counties where already promoted if any	Nyandarua, Nakuru and Laikipia
Counties where TIMP will be upscaled	Laikipia, Baringo, Elgeyo Marakwet, Machakos, Kakamega, Kericho, Lamu, Kajiado, Machakos, Nyandarua, Taita Taveta, Tharaka Nithi, Uasin Gishu, West Pokot
Challenges in dissemination	High Equipment cost Lack of local source of ingredients Milk adulteration Inadequate trainers Regulatory requirements
Recommendations for addressing the challenges	Financial facilitation Training Capacity building of trainers Enquiry of market information
Lessons learned	Ready market for value added products exist
Social, environmental, policy and market conditions necessary	Good milk market Appropriate training and demonstration sites
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 85.90 per litre
Estimated returns	KES 130 per litre
Gender issues and concerns in development and dissemination	Both genders can effectively participate in development and dissemination
Gender issues and concerns in adoption and scaling up	Both genders can effectively participate in adoption and scaling up.
Gender related opportunities	Improved livelihoods among the members of the society who will adopt this technology
VMG issues and concerns in development and dissemination	Improved livelihoods among the vulnerable members of the society who will adopt this technology

VMG issues and concerns in adoption and scaling up	Cost of processing equipment and lack of processing skills
VMG related opportunities	Improved incomes that enhance livelihoods
E: Case studies/profiles of success stories	
Success stories	Commercial yoghurt production in KALRO Ol Joro Orok and Naivasha
Application guidelines for users	Pamphlets, farmer booklets, training manuals
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research)	Ready for upscaling and Requires validation
G: Contacts	
Contacts	Centre Director KALRO Ol Joro Orok
Lead organization and scientists	N.N Kanegeni, N. Mathai, D. Mbugua and P. Alaru
Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

Gaps:

1. Validation of different products, additive, flavours and colours to suit customer tastes and preferences
2. Lack of appropriate equipment for processing and cost saving for production

2.5.4 Technology name	**Butter production from dairy milk**
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Low incomes from raw milk Milk glut Shelf life issues
What is it? (TIMP description)	Butter is a fatty product exclusively from milk whose composition is as follows:- Milk fat 80%, Milk solids nonfat: max 2% , Water: max 16%
Justification	Better income Improve livelihoods Reduce wastage during milk glut
Region promoted	Nyandarua and other milk producing areas
B: Assessment of dissemination and scaling up/out approaches	
Users of TIMP	Small holder dairy farmers
Approaches used in dissemination	Demonstrations, practical training sessions, field days
Most effective approach	Practical hands on training
Critical/essential factors for successful promotion	Availability of quality milk Attractive markets for dairy product Appropriate training Affordable equipment

Partners/stakeholders for scaling up and their roles	Kenya Dairy Board Cooperatives Extension service providers Self-help groups
C: Current situation and future scaling up	
Current extent of reach	Low
Challenges in dissemination	High equipment cost Lack of local sources of ingredients Adulterated milk Inadequate trainers Regulatory requirements
Recommendations for addressing the challenges	Financial facilitation Training Capacity building of trainers Enquiry of market information
Lessons learned	Ready market for value added products exist
Social, environmental, policy and market conditions necessary	Good milk market Appropriate training and demonstration sites
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	KES 300 per kg
Estimated returns	KES 1000 per kg
Gender issues and concerns in development and dissemination	Both genders can effectively participate in development and dissemination
Gender issues and concerns in adoption and scaling up	Both genders can effectively participate in adoption and scaling up.
Gender related opportunities	Improved livelihoods among the members of the society who will adopt this technology
VMG issues and concerns in development and dissemination	Improved livelihoods among the vulnerable members of the society who will adopt this technology
VMG issues and concerns in adoption and scaling up	
VMG related opportunities	
E: Case studies/profiles of success stories	
Success stories	
Application guidelines for users	Pamphlets, farmer booklets, training manuals
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
Lead organization and scientists	KALRO, N.N Kanegeni, N Mathai and D. Mbugua

Partner organizations	County government of Nyandarua, KDB, KEBS, Public health

Gaps:

1. Validation of different products, additive, flavours and colours to suit customer tastes and preferences
2. Lack of appropriate equipment for processing and cost saving for production

2.6 Manure management for bioenergy

2.6.1 TIMP name	**Utilization of domestic biogas**
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	- Domestic energy insecurity - Poor soil fertility and structure and low crop productivity - GHG emissions
What is it? (TIMP description)	- Domestic biogas technology come in various designs but can be described generally as either fixed domes, floating drum or tubular models. - Biogas plants through anaerobic digestion convert organic wastes into biogas (combustible mixture of methane and carbon dioxide) and high-quality fertilizer. Gas can be used for domestic use replacing other biomass fuels (charcoal, firewood). -
Justification	- Bio slurry from anaerobic digesters can be used to improve soil fertility, soil structure and crop productivity and reduces need for constant use of chemical fertilizers. - The lack of access to affordable and efficient energy leads to the dominance of biomass in residential energy supply and attendant forest cover depletion - Domestic biogas digesters help in mitigating GHG emissions, reduce biomass fuel consumption and since biogas burns without smoke, it reduces apparent indoor air pollution. - The Energy Act 2006 has provisions for promotion of renewable energy, which includes biogas. Green energy (used in place of charcoal, and firewood) reduces burden on forest resources - The technology is carbon neutral, and therefore does not add or remove carbon dioxide from the atmosphere. 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 - Middle sized (e.g. schools) and large institutions (e.g. universities)
Approaches to be used in dissemination	- On farm Demonstrations - Farmer Field Schools
Critical/essential factors for successful promotion	- Affordability - A firm and solid "business case" made to entice more users - Availability and accessibility to 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 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 institutions—KWFT, Equity - Regulatory bodies (ERC, KEBS)—develop and provide guidelines to regulate sector - Line ministries a. Ministry of finance (National treasury)—provide a link to carbon markets as the National Designated Authority (NDA) to the Green Climate Fund in Kenya b. State Department of Livestock—implementation of the dairy NAMA
C: Current situation and future scaling up	
Counties where already promoted if any	KCSAP & non-KCSAP counties: Kilifi, Kiambu, Kajiado, West Pokot, Narok, Baringo, Laikipia, Machakos, Nyeri, Tharaka Nithi, Lamu, Taita Taveta, Busia, Siaya, Nyandarua, Bomet, Kericho, Kakamega, Uasin Gishu, Elgeyo Marakwet, Kisumu. Kirinyaga, Muranga, Embu, Meru, Bungoma, Vihiga, Nandi, Tana River, Mombasa, Nairobi, Kajiado, Machakos, Makueni, Kitui, Trans Nzoia, Kisii, Nyamira,
Counties where TIMP will be upscaled	Marsabit, Isiolo, Tana River, Garissa, Wajir, Mandera,
Challenges in dissemination	- High initial investment (installation) costs coupled with low level of financial support and low incomes - No vibrancy among financial institutions to support the uptake of domestic biogas systems - Low levels of awareness and/or understanding of system and related opportunities (e.g. climate finance) - Lack of adequate and/or consistent water supply

	- Technology incompatibility in the absence of sedentary lifestyles (e.g. pastoral livelihoods) - Challenges in acceptance of plants attached to human waste streams - Relatively high technology abandonment rates
Suggestions for addressing the challenges	- A well-crafted incentive structure (e.g. rebates) and development of financial products to offset high initial investment - Accessible demonstrations to help demystify the technology and sensitization about available carbon trading platforms - Improved water harvesting technologies - Direct government support at national and county level with firm policies - Build capacity and knowledge about available and potential substrate sources (e.g. castor seedcake) - Structure service and maintenance to fit into the overall dissemination strategy (e.g. create customer service centres and hold repair campaigns).
Lessons learned in upscaling if any	- The role of research and development in ensuring that the product fits market needs - 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 undertaking zero grazing - 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
D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations	
Basic costs	Estimated installation costs for 8 m3 sized plant (in 2014). (*NB: Modified designs potentially 25% cheaper to construct*) - Fixed dome (80,000)

	- Floating drum (75,000) - Tubular (flexi-biogas) (KES 50,000
Estimated returns	- For each biogas unit, direct financial savings are estimated at KES20,400 per year - Women and children save up to 5 hours each week which they would otherwise spend fetching firewood and thus labour savings are available for other productive tasks as well as leisure. - Saves women and children from indoor smoke; and respiratory distress and ailments
Gender issues and concerns in development and dissemination	- Time spent mainly by women in search for fuelwood reduced by a large margin - However, water demand to run the plants an added "cost"/time for women and youths
Gender issues and concerns in adoption and scaling up	- 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.
Gender related opportunities	- Women groups can turn the Biogas technologies into a Business opportunity through marketing and engaging in the installation of plants
VMG issues and concerns in development and dissemination	- Innovative financing including lease to own over a long period of time to ensure affordable terms in accessing the technology - Rebates and other financial instruments to lower the initial cost of acquiring the technology
VMG issues and concerns in adoption and scaling up	- Target VMGs for promotion of biogas technology among members and ensure they are included in scaling - The existence of pro-environmental attitudes not clear.
VMG related opportunities	- VMGs can use slurry as a business opportunity
E: Case studies/profiles of success stories	
Success stories from previous similar projects	- The Africa Biogas Partnership Program through the Kenya Biogas Programme (KBP) - over 13,200 plants installed in 42 counties over the period 2009-2017 - Ongoing research under the National Research Fund supported biogas project in Kiambu and Machakos counties - SDCP (IFAD) through Biogas International-the installation of flexi-biogas systems in selected counties
Application guidelines for users	- The KBP has developed a guide on operation and maintenance of the KENBIM model - It also has developed a guide on the use of bio slurry from the system
F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires	Ready for upscaling

validation; 3. Requires further research)	
G: Contacts	
Contacts	Centre Director, KALRO- Naivasha
Lead organization and scientists	KALRO, William Ayako, 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

Gaps

Need for standards for prefabricated systems and standards for use of organic fertilizer from the biodigesters

Annex: (Other TIMPS)

I. Substitution of maize with cassava in dairy feeds, Technology Ready for upscaling (information to be provided by Prof. Okoth Ogendo of Egerton University)
II. Fortified (Biochar and Bentonite) Urea-treated Maize stover feed blocks to mitigate Greenhouse gas
III. Dairy feed and milk safety sensitization