



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



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DISCLAIMER

The information presented in this inventory of Technologies, Innovations and Management Practices (TIMPs) book is for advisory use only. Users of this book should seek additional advice from the livestock extension service to fully benefit from the inventory recommendations.

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FOREWORD

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

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

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

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

PREFACE

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

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

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

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

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

Francis Muthami

National Project Coordinator

Kenya Climate-Smart Agriculture Project

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ABBREVIATIONS AND ACRONYMS

| | |
|---------|--|
| KCSAP | Kenya Climate-Smart Agriculture Project |
| KALRO | Kenya Agricultural and Livestock Research Organization |
| TIMPs | Technologies, Innovations and Management Practices |
| NARS | National Agricultural Research System (NARS) |
| CSA | climate smart agriculture |
| ToT | Training of Trainers |
| ASALs | Arid and Semi-arid Lands |
| PDO | project development objective |
| GHG | Greenhouse gas |
| CGIAR | Consultative Group for International Agricultural Research |
| NPCU | National Project Coordination Unit |
| SEAZ | Small East African Zebu |
| ASK | Agricultural Society of Kenya |
| ADC | Agricultural Development Corporation |
| KMC | Kenya Meat Commission |
| KAGRC | Kenya Animal Genetics Resource Centre |
| KLBA | Kenya Livestock breeders association |
| KEVEVAP | Kenya Veterinary Vaccine Production |
| ENDA | Ewaso Nyiro Development Authority |
| VMGs | Vulnerable and marginalized groups |
| CBOs | Community Based Organizations, |
| KAGRC | Kenya Animal Genetic Resources Centre |
| AI | Artificial Insemination |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| KEPHIS | Kenya Plant Health Inspectorate Services |
| NPT | National Performance Trial |
| DUS | Distinctness, Uniformity and Stability |
| CWC | Community Wildlife Conservancies |
| KWS | Kenya Wildlife Service |
| ENDA | Ewaso Nyiro Development Authority |
| TARDA | Tana, Athi River Development Authority |
| IPR | Intellectual Property Rights |

1.0 Definition of terms and summary tables of Red Meat 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 Red Meat Value Chain (Beef)

The inventory process resulted in a total of 39 TIMPs including 39 technologies, 0 innovations and 10 management practices, distributed among the 2 sub-themes, as indicated in Table 1.

Table 1. Number of TIMPs in the Red Meat Value Chain (Beef)

| Commodity/VC | Sub-Theme | Technologies | Innovations | Management Practices |
|----------------------|----------------------|--------------|-------------|----------------------|
| Red Meat | Breeds | 6 | 0 | |
| Red Meat | Fodder | 11 | 0 | 0 |
| Red Meat | Management Practices | | | 5 |
| Red Meat | Beef Cattle Health | 12 | | 5 |
| Overall Total | | 29 | 0 | 10 |

1.3 Summary of Status of TIMPs in Red Meat Value Chain (Beef)

The inventory process resulted in a total of 21 TIMPs that are ready for up scaling, 8 TIMPs that require validation and 9 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 |
|----------------------|----------------------|---------------------|--------------------|------------------|
| Red Meat | Breeds | 4 | 0 | 2 |
| Red Meat | Fodder | 5 | 2 | 4 |
| | Management Practices | 3 | 0 | 1 |
| Red Meat | Beef Cattle Health | 9 | 6 | 2 |
| Overall Total | | 21 | 8 | 9 |

Table 3: Inventory of Red Meat TIMPs by Category and Status

| TIMPs Sub-Theme | TIMPs Title | TIMPs Category | Status |
|-----------------|--|----------------|---------------------------|
| 2.1 Breeds | 2.1.1 Improved Boran | Technology | Ready for upscaling |
| | 2.1.2 Improved Boran/Red Poll Terminal Crosses In-Calf Heifers | Technology | Ready for upscaling |
| | 2.1.3 Improved Boran/Sahiwal Heifers | Technology | Ready for upscaling |
| | 2.1.4 Sahiwal | Technology | Ready for upscaling |
| | 2.1.5 Orma Boran | Technology | Require further research |
| | 2.1.6 Small East African Zebu (SEAZ) | Technology | Require further research |
| 2.2 Fodder | 2.2.1 Dual purpose sorghums (Ikinyaruka) | Technology | Requires validation |
| | 2.2.2 Dual purpose sorghums (E1291) | Technology | Requires validation |
| | 2.2.3 Dual purpose sorghums (BJ 28) | Technology | Requires further research |
| | 2.2.4 Dual purpose sorghums (BM 30) | Technology | Requires further research |
| | 2.2.5 <i>X - Tozi</i> | Technology | Requires further research |
| | 2.2.6 Chloris Gayana | Technology | Ready for upscaling |
| | 2.2.7 Clitoria (<i>Clitoria ternatea</i>) | Technology | Ready for upscaling |
| | 2.2.8 Sweet Potato (Wagaborige) | Technology | Requires further research |
| | 2.2.9 Brachiaria Variety Busia | Technology | Ready for upscaling |

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| | | | |
| | 2.2.10 Forage Sorghum (E6518) | Technology | Ready for upscaling |
| | 2.2.11 Tree Lucerne | Technology | Ready for upscaling |
| 2.3 Management practices | 2.3.1 Use of heart girth band to estimate improved Boran and other <i>Bos indicus</i> live weight | Management practice | Requires further research |
| | 2.3.2 50 :50 milking suckling regime | Management practice | Ready for upscaling |
| | 2.2.3 Integrating beef in Wildlife conservancies | Management practice | Ready for upscaling |
| | 2.3.4. Beef marketing | Management practice | Ready for upscaling |
| 2.4 Beef Cattle Animal Health | 2.4.1.1 <i>Theileria parva</i> Marikebuni East Coast fever (ECF) vaccine | Technology | Ready for up-scaling |
| 2.4.1 Vaccines | 2.4.1.2 Sub-Unit Contagious Bovine Pleuro-pneumonia vaccine | Technology | Requires field validation |
| | 2.4.1.3 Thermo-tolerant peste des petits ruminants vaccine | Technology | Requires field validation |
| | 2.4.1.4 Contagious Bovine Pleuro-pneumonia DIVA vaccine | Technology | Requires field validation |
| | 2.4.1.5 Recombinant HC58 DNA Vaccine | Technology | Require further research |
| 2.4.2. Diagnostic tests | 2.4.2.1 pH-based mastitis kit | Technolog | Requires field validation |
| | 2.4.2.2 Protein tagged latex agglutination test for Contagious Bovine Pleuro-pneumonia | Technology | Requires field validation |
| 2.4.3 Disease control strategies | 2.4.3.1 Integrated helminth control | Management practice | Ready for scaling/capacity building required |
| | 2.4.3.2 Push-pull Tsetse fly control | Technology | Require field validation |
| 2.4.4 Medicated feed supplements | 2.4.4.1 Medicated Molasses Urea Mineral blocks (MUMBs) | Technology | Ready for up-scaling |

2.1 Improved Breeds

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| 2.1.1 TIMP Name | Improved Boran |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity, slow growth rates, low maturity weights and low carcass quality from indigenous breeds |
| What is it? (TIMP description) | <p>Improved Boran cattle is a climate smart breed that has the following attributes: withstands high ambient temperatures, resistant to diseases and pests. high feed conversion ratio, high quality meat, high meat output i.e., Maturity at 30-36 months to attain 400 body live weight, high growth rate, high (60%) carcass dressed weight, acceptable breed colour (brown; fawn, grey and bristle) by Boran Breeders Association and breeder communities, high meat bone ratio,60:40 and efficient feed utilizer that reduce GHGs emission.</p>  <p style="text-align: center;"><i>Improved Boran Bull</i></p> |
| Justification | Indigenous Boran breed has a slow growth rate, poor feed conversion efficiency, low quality carcass, attain maturity weight at later age of 42 months and above compared to improved Boran. Therefore, the improved Boran breed was bred and developed to address the aforementioned short comings in the local breeds. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers, extension service providers, researchers, Universities and Tertiary Institution. |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Digital platforms agricultural innovation platforms, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, Promotion of technology park and technology shows, conferences and symposiums. |

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| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Need for a stable and reliable beef market and competitive beef cattle breeders who are producing for markets. • High quality and quantity feeds to sustain improved productivity of the breeds. • Effective animal health delivery systems. • Enrolment with breeders associations for quality assurance. • Product diversification and value addition to increase profitability. |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Universities- Collaborate in technology development and capacity building for the scientists. • Community breeders groups-multiply quality breeding stock for farmers at County level. • Ranchers and ADC farms - for breed multiplication at County level. • County Government - to support farmers in the uptake of the technology • NGOs - to support farmers in the uptake of the technology • Pastoral breeder groups - to form training platforms to access the technology • Pastoralists- to uptake the technology • Kenya Livestock Marketing Council - build farmer capacity to access the breed • KMC and red meat processors - provide market for the product • Kenya Animal Genetics Resource Centre (KAGRC) - to provide semen • Boran cattle breeders association- quality assurance • Kenya Livestock breeders association(KLBA)- registration of breeds in Kenya Stud book • KEVAVAP-Vaccine production • Livestock feeds manufacturers –Production of quality feeds • Agro-vets-To dispense quality treatment drugs • Ewaso Nyiro Development Authority (ENDA), Wildlife conservancies and Tana Athi River Development Authority to multiply the breed |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Machakos, Makueni and Taita Taveta, Nakuru, Laikipia Kajiado, Nyeri, Narok |
| Counties where TIMP will be up scaled | Isiolo, Taita Taveta, Tana River, Wajir, Lamu and Marsbit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Limited commercial orientation among pastoral and agro-pastoral beef keepers • Limited resources for extension services • High illiteracy levels |


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| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling beef production infrastructure in ASALs • Transformation of pastoralism to agribusiness and contract farming. • Enhance dissemination of the beef technology • Promote farmers field schools and adult education. • National and County Governments to Increase funding for dissemination of modern beef TIMPs |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • The breed is in high demand in Kenya, East Africa and world wide • Production of improved Boran is highly profitable • Current cost of the technology is high |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • County government to develop a policy to sale cattle using body live weight, • Disease free zones/ Disease control zones, to widen the Market of beef cattle especially the export market • Improve the market infrastructure • Formalization of cross border trade on meat • Reduce GHGs emissions through efficient breeds that has high feed body conversion ratio to effectively digest poor quality feeds. • Breeding climate smart beef breeds and pasture and fodder varieties |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost of Unregistered Bull KES 100,000 -130,000; Registered Bull sold at KES 240,000 |
| Estimated returns | <ul style="list-style-type: none"> • Sale price: KES 120,000 • Cost of Production under free range: KES 4,373.20. • Estimated returns per Unregistered bull: KES 115,500 while for a Registered bull – KES 135,500 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Men and youth who are mainly involved in breed selection lack finances to buy a bull whose cost is too high • Inadequate awareness of the existence of different breeds of beef breeds especially among women who have low literacy level, leading to relatively low adoption rates • Poor access to the other resources needed e.g. credit, • information and awareness flow • Women and youth have limited access to beef markets technology |
| Gender related opportunities | <ul style="list-style-type: none"> • Need for alternative technologies such Artificial Insemination because of the high cost of bull |

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| | <ul style="list-style-type: none"> • Deliberate efforts to build the capacity of women headed households as breeding in most communities is a male dominated activity • Training men, women and youth on appropriate breeding practices and on beef production as a business • Men, women and youth can take up the production of breeding bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition and increased income • Have well organized gender friendly markets and marketing systems for beef • as women are more involved in milk marketing • Make credit accessible to all gender categories |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The high cost of the bull may exclude adoption by VMGs who have poor access to the resources needed e.g. credit • Limited awareness on existence of different beef breeds by VMGs • Information and awareness flow among VMGs is Slow due to their low education levels • VMGs have limited access to beef markets technology |
| VMG related opportunities | <ul style="list-style-type: none"> • The capacity of the VMGs to access and utilize beef breeding technologies should be enhanced • VMG can produce the bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition, increased income and increased involvement of men, women and youth • Have well organized VMGs friendly markets and marketing systems for bulls and beef • Make credit accessible to VMGs • Target VMGs in beef breeding upscaling activities |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • The Improved Boran is the breed of choice for most ranchers and pastoralists in Kenya and worldwide • It is also the breed of choice for crossbreeding to increase hybrid vigor in beef industry. • Some producers in Laikipia , Taita Taveta, Machakos and Makueni ranches produce the breed (bulls, in-calf heifers, steers) for sale |
| Application guidelines for users | Tura et al. (2022) Beef Cattle Production Extension Manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for upscaling |

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| G. Contacts | Director Beef Research Institute, KALRO Lanet P. O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

Research Gaps

1. Inadequate breeding bulls and breeding heifers
2. Limited awareness of the breed among pastoral and agro-pastoral producers leading to relatively low adoption rates
3. Limited adaptation studies in most areas
4. Limited beef finishing rations
5. Evaluation of Improved Boran breed contribution to greenhouse gas emission under different production systems

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| 2.1.2 TIMP name | Improved Boran/Red Poll Terminal Crosses In-Calf Heifers |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity of indigenous dual purpose breeds in the ASALs, low milk and beef output. |
| What is it? (TIMP description) | It is a dual-purpose cattle breed that provides both meat and milk in ASALs. It produces up-to 10 litres of milk daily. The breed is tolerant to both diseases, parasites and high temperatures as well as utilizes poor quality feeds. It has high (250-350 kg) maturity weight at 30-36 months and carcass dressed weight of 60% for steers.  <p><i>Redpoll X Boran</i></p> |
| Justification | Kenya is red meat deficit Country with about 100,000MT annual beef deficit. There is an increasing demand for beef in Kenya and |

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| | thus high demand for fast growing adaptable dual purpose beef breeds. In addition, cross-breeds have increased meat and milk outputs compared to local zebu cattle. In addition, the changing consumption habits for the increasing affluent Kenyan population is demanding high quality beef and milk. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Need for a stable and reliable beef and milk market. • High quality and quantity feeds to sustain improved productivity of the cross-breeds. • Effective animal health delivery systems. • High adoption of dual-purpose cross breeds • Product diversification and value addition to increase profitability |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Ranchers - for breed multiplication • County Government - to support farmers in the uptake of the technology • NGOs - to support farmers in the uptake of the technology • Pastoral groups - to form training platform to ease access to the technology • Kenya Livestock Marketing Council - Build farmer capacity to access the breed • KMC and red meat processors - provide beef market • ENDA and Tana and Athi River Development Authority (TARDA) - breed multiplication • KAGRC- to provide semen |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Kisumu, Laikipia ranches, Kajiado |
| Counties where TIMP will be up scaled | Isiolo, Taita Taveta, Tana River, Wajir, Lamu,garissa,mandera and Marsbit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists with no commercial orientation • Limited resources • High illiteracy levels |


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| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling beef production infrastructure in ASALs • Enhance dissemination of the beef technology • Transformation of pastoralism to agribusiness and contract farming. • Promote farmers field schools and adult education. |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • The cross-breed is hardy and well adapted in ASALs in semi-intensive system. |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Market intervention to promote sale on live weight basis • Disease free zones/ Disease control zones, to widen the Market of beef cattle especially the export market • Improve the market infrastructure • Formalization of cross border trade on meat • Reduce GHGs emissions • Some communities require animals with a certain colour and that may require sensitization • Strategic feed reserves and seed systems in the ASALs |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost of in-calf heifers: KES 130,000 |
| Estimated returns | Cost of production under free range KES 4,373.20 Estimated returns KES 125,627 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Men and youth who are mainly involved in breed selection lack finances to buy a bull whose cost is too high • Inadequate awareness of the existence of different breeds of beef breeds especially among women who have low literacy level, leading to relatively low adoption rates • Poor access to the other resources needed e.g. credit, information and awareness flow • Women and youth have limited access to beef markets technology |
| Gender related opportunities | <ul style="list-style-type: none"> • Need for alternative technologies such Artificial Insemination because of the high cost of bull • Deliberate efforts to build the capacity of women headed households as breeding in most communities is a male dominated activity • Training men, women and youth on appropriate breeding practices and on beef production as a business • Men, women and youth can take up the production of breeding bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition and increased income • Have well organized gender friendly markets and marketing |

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| | <p>systems for beef as women are more involved in milk marketing</p> <ul style="list-style-type: none"> • Make credit accessible to all gender categories |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The high cost of the bull may exclude adoption by VMGs who have poor access to the resources needed e.g. credit • Limited awareness on existence of different beef breeds by VMGs • Information and awareness flow among VMGs is Slow due to their low education levels • VMGs have limited access to beef markets technology |
| VMG related opportunities | <ul style="list-style-type: none"> • The capacity of the VMGs to access and utilize beef breeding technologies should be enhanced • VMG can produce the bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition, increased income and increased involvement of men, women and youth • Have well organized VMGs friendly markets and marketing systems for bulls and beef • Make credit accessible to VMGs • Target VMGs in beef breeding upscaling activities |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | The Improved Boran x Red Poll cross were piloted in ASALs Counties of Isiolo and Marsabit during dry season in semi-intensive pastoral system and at watering interval of two days. The cross-breeds adapted well under harsh ASALs climatic conditions and poor feeds. |
| Application guidelines for users | <ul style="list-style-type: none"> • F1 heifers could be served by beef or dairy bull depending on preference (Milk or meat) of the farmer. • Feed the in-calf female well when it calves down for milk production to be shared by farmer and calf. • Observe appropriate animal husbandry practices and health. • F1 Females can be served by good bull or AI <p>Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for upscaling |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P. O. Box 3840-20100 Nakuru Email: directorbri@karo.org |

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| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

GAPS

1. Inadequate number of F1 heifers and steers.
2. Lack of management packages for cross-breed.
3. Lack beef finishing rations in ASALs.
4. Low awareness of the breed among pastoral and agro-pastoral producers and availability of AI leading to relatively low adoption rates
5. Inadequate Artificial Insemination infrastructure (Technical staff and artificial insemination kits)
6. Performance (meat and milk) of the breeds under ASALs conditions unknown
7. Evaluation of the steers on growth and meat quality under different feeding regimes unknown

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| 2.1.3 TIMP name | Improved Boran/Sahiwal heifers |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity of indigenous dual purpose breeds in the ASALs, low milk and beef output |
| What is it? (TIMP description) | <p>It is dual-purpose cattle breed for both meat and milk with improved udder setting and suspension. It is tolerant to diseases and high temperatures and utilizes poor quality forage. Steers have high (420 kg) maturity weight at 30-36 months with high (60%) dressed carcass weight and quality. Steers are relatively big and have higher growth rates compared to the founding breeds.</p>  <p><i>Improved Boran X Sahiwal</i></p> |
| Justification | Kenya is red meat deficit Country with about 100,000MT annual beef deficit. There is an increasing demand for beef in Kenya and |

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| | thus high demand for fast growing adaptable dual purpose beef breeds especially in ASALs. Improved Boran x Sahiwal cross produce both milk and quality beef in the ASALs at relatively low cost i.e., It can be finished on grass only compared to the grain finished beef thus less GHG production. It utilizes low digestible forages and have high feed conversion ratio. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Need for a stable and reliable beef and milk market. • High quality and quantity feeds to sustain improved productivity of the cross-breeds. • Effective animal health delivery systems. • High adoption of dual-purpose cross breeds • Product diversification and value addition to increase profitability • Promotion of feedlot system for increased income. |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Ranchers - for breed multiplication • County Government - to support farmers in the uptake of the technology • NGOs - to support farmers in the uptake of the technology • Pastoral groups - to form training platform to ease access to the technology • Kenya Livestock Marketing Council - Build farmer capacity to access the breed • KMC and red meat processors - provide beef market • ENDA and Tana and Athi River Development Authority (TARDA) - breed multiplication • KAGRC- to provide semen |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | In Laikipia County ranches, Kisumu, Nakuru in KALRO Lanet |
| Counties where TIMP will be up scaled | Isiolo, Taita Taveta, Tana River, Wajir, Lamu,garissa,mandera and Marsbit Lamu, Narok,kajiado |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists with no commercial orientation |


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| | <ul style="list-style-type: none"> • Limited resources • High illiteracy levels |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling beef production infrastructure in ASALs • Enhance dissemination of the beef technology • Transformation of pastoralism to agribusiness and contract farming. • Promote farmers field schools and adult education. |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • The breed has reduced incidence of mastitis due to the improved udder setting. • The breed is hardier than the pure Sahiwal |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Market intervention to promote sale on live weight basis • Disease free zones/ Disease control zones, to widen the Market of beef cattle especially the export market • Improve the market infrastructure • Formalization of cross border trade on meat • Reduce GHGs emissions • Strategic feed reserves and seed systems in the ASALs. • The crosses are mainly brown which is acceptable colors among many Kenyan communities |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost of in-calf heifers: KES 130,000 |
| Estimated returns | Cost of production under free range KES 4,373.20 Estimated returns KES 125,627 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Encouraging women to participate in beef marketing • Men and youth who are mainly involved in breed selection lack finances to buy a bull whose cost is too high • Inadequate awareness of the existence of different breeds of beef breeds especially among women who have low literacy level, leading to relatively low adoption rates • Poor access to the other resources needed e.g. credit, information and awareness flow • Women and youth have limited access to beef markets technology |
| Gender related opportunities | <ul style="list-style-type: none"> • Need for alternative technologies such Artificial Insemination because of the high cost of bull • Deliberate efforts to build the capacity of women headed households as breeding in most communities is a male dominated activity • Training men, women and youth on appropriate breeding practices and on beef production as a business |

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| | <ul style="list-style-type: none"> • Men, women and youth can take up the production of breeding bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition and increased income • Have well organized gender friendly markets and marketing systems for beef as women are more involved in milk marketing • Make credit accessible to all gender categories |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The high cost of the bull may exclude adoption by VMGs who have poor access to the resources needed e.g. credit • Limited awareness on existence of different beef breeds by VMGs • Information and awareness flow among VMGs is Slow due to their low education levels • VMGs have limited access to beef markets technology |
| VMG related opportunities | <ul style="list-style-type: none"> • The capacity of the VMGs to access and utilize beef breeding technologies should be enhanced • VMG can produce the bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition, increased income and increased involvement of men, women and youth • Have well organized VMGs friendly markets and marketing systems for bulls and beef • Make credit accessible to VMGs • Target VMGs in beef breeding upscaling activities |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | The Improved Boran x Sahiwal cross were piloted in ASALs Counties of Isiolo and Marsabit during dry season in semi-intensive pastoral system and at watering interval of two days. The cross-breeds adapted well under harsh ASALs climatic conditions and poor feeds. |
| Application guidelines for users | <ul style="list-style-type: none"> • F1 heifers could be served by beef or dairy bull depending on preference (Milk or meat) of the farmer. • Feed the in-calf female well when it calves down for milk production to be shared by farmer and calf. • Observe appropriate animal husbandry practices and health. • F1 Females can be served by good bull or AI. <p>Further reference: Beef technical and extension manual (2022)</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for upscaling |
| G. Contacts | Director Beef Research Institute, KALRO Lanet |

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| | P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

GAPS

1. Inadequate number of F1 heifers and steers.
2. Lack of management packages
3. Lack of finishing rations
4. Low awareness of the breed and inadequate use of AI among pastoral and agro-pastoral producers
5. Inadequate Artificial Insemination infrastructure (Technical staff and artificial insemination kits)
6. Inadequate information on the performance (meat and milk) of the breed under ASAL conditions
7. Evaluation of the steers on growth and meat quality under different feeding regimes.

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| 2.1.4 TIMP Name | Sahiwal |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity of indigenous dual purpose breeds in the ASALs and low milk and beef output |
| What is it? (TIMP description) | It is a dual-purpose (meat and milk) cattle breed. The breed is relatively tolerant to diseases, parasites, and high temperatures and utilizes poor quality feed. It has high maturity weight with males weighing 300 kg at 24 months and females 270 kg in 27 month and produces high-quality beef. |
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| | <i>Sahiwal Bull, KALRO Naivasha</i> |

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| Justification | Sahiwal produce high quality beef and yields more milk than other Zebus in the ASALs at a relatively low cost. It can be finished on grass only compared to the grain finished beef thus less GHG production. It utilizes low digestible forage and has high feed conversion ratio (feed: weight gain). |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Need for a stable and reliable beef and milk market • High quality and quantity feeds • Effective animal health delivery systems • High adoption of dual-purpose breed • Product diversification and value addition to increase profitability • Promotion of feedlot system for increased income |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Ranchers - for breed multiplication • County Government - to support farmers in the uptake of the technology • NGOs - to support farmers in the uptake of the technology • Pastoral groups - to form training platform to ease access to the technology • Kenya Livestock Marketing Council - Build farmer capacity to access the breed • KMC and red meat processors - provide beef market • ENDA and Tana and Athi River Development Authority (TARDA) - breed multiplication • KAGRC- to provide semen |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Ranches in: Narok, Kajiado, Laikipia, Mandera , KALRO Naivasha |
| Counties where TIMP will be up scaled | Isiolo, Taita Taveta, Tana River, Wajir, Lamu,garissa,mandera and Marsbit Lamu, Narok,kajiado |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists with no commercial orientation • Limited resources • High illiteracy levels |


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| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling beef production infrastructure in ASALs • Enhance dissemination of the beef technology • Transformation of pastoralism to agribusiness and contract farming. • Promote farmers field schools and adult education. |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Breed is in high demand in East Africa • The production of the Sahiwal is highly profitable • Breed is adaptable in different agro-ecological zones • Ability to walk long distances in search of forage |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Market intervention to promote sale on live weight basis • Disease free zones/ Disease control zones, to widen the Market of beef cattle especially the export market • Improve the market infrastructure • Formalization of cross border trade on meat • Reduce GHGs emissions • Strategic feed reserves and seed systems in the ASALs. • The colour of Sahiwal is preferred among many pastoral communities |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost of in-calf heifers: KES 130,000 |
| Estimated returns | Cost of production under free range KES 4,373.20 Estimated returns KES 125,627 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Men and youth who are mainly involved in breed selection lack finances to buy a bull whose cost is too high • Inadequate awareness of the existence of different breeds of beef breeds especially among women who have low literacy level, leading to relatively low adoption rates • Poor access to the other resources needed e.g. credit, information and awareness flow • Women and youth have limited access to beef markets technology |
| Gender related opportunities | <ul style="list-style-type: none"> • Need for alternative technologies such Artificial Insemination because of the high cost of bull • Deliberate efforts to build the capacity of women headed households as breeding in most communities is a male dominated activity • Training men, women and youth on appropriate breeding practices and on beef production as a business • Men, women and youth can take up the production of breeding bulls and heifers as a business • Improved breeds will lead to increased meat production |

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| | <p>hence improved household nutrition and increased income</p> <ul style="list-style-type: none"> • Have well organized gender friendly markets and marketing systems for beef as women are more involved in milk marketing • Make credit accessible to all gender categories |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The high cost of the bull may exclude adoption by VMGs who have poor access to the resources needed e.g. credit • Limited awareness on existence of different beef breeds by VMGs • Information and awareness flow among VMGs is Slow due to their low education levels • VMGs have limited access to beef markets technology |
| VMG related opportunities | <ul style="list-style-type: none"> • The capacity of the VMGs to access and utilize beef breeding technologies should be enhanced • VMG can produce the bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition, increased income and increased involvement of men, women and youth • Have well organized VMGs friendly markets and marketing systems for bulls and beef • Make credit accessible to VMGs • Target VMGs in beef breeding upscaling activities |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | It is the breed of choice for pastoralists in southern semi-arid areas and ranches. In Kajiado County, the Maasai call it ' <i>Rangi ya pesa/colour of money</i> ' |
| Application guidelines for users | <ul style="list-style-type: none"> • Use a Sahiwal bull or AI • Maintain the bull in good condition • Bull: cow ratio should be 1:40 depending on the environment. • Supplement herds during droughts <p>Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for upscaling |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Sahiwal Breeders Association, County Government, Universities |

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| | (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |
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GAPS

1. Narrow genetic base – inject new blood of Sahiwal from India and Pakistan
2. Inadequate awareness of the breed among pastoral and agro-pastoral producers leading to relatively low adoption rates
3. Lack of adaptation studies under different pasture and watering regimes
4. Lack of beef finishing rations/systems
5. Evaluation of the breed contribution to greenhouse gas emission under different production systems

| 2.1.5 TIMP Name | Orma Boran |
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| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity due to high incidence of trypanosomosis and widespread trypanocide resistance |
| What is it? (TIMP description) | <p>It is a dual-purpose (meat and milk) indigenous cattle breed. The breed is trypano-tolerant and is disease resistant including parasites, and withstand high temperatures and utilizes poor quality feed. It has high maturity weight with males weighing 300 kg at 24 months and females 270 kg in 27 month and produces high-quality beef.</p>  |
| Justification | High mortality due to trypanosomiasis in tsetse infested areas is a set-back to most livestock keepers and affects livelihoods negatively. Trypanosomiasis is controlled and treated using chemical formulation, whose effect on the environment is hazardous. The Orma Boran trypano-tolerance trait can be used to minimize livestock loses and environmental pollution by the chemical formulations. The gene could be isolated and placed in high yielding beef breeds or composites breeds which are trypano-tolerant could be developed through cross-breeding programme. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers |

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| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Selection of the breed and its multiplication • Availability of the breed • Creation of awareness of the breed • Registration of the breed. • Availability of adequate feeds • High demand for milk and meat |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Ranchers - for breed multiplication • County Government - to support farmers in the uptake of the technology • NGOs - to support farmers in the uptake of the technology • Pastoral groups - to form training platform to ease access to the technology • Kenya Livestock Marketing Council - Build farmer capacity to access the breed • KMC and red meat processors - provide beef market • ENDA and Tana and Athi River Development Authority (TARDA) - breed multiplication • KAGRC- to provide semen |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Garissa, Tana River |
| Counties where TIMP will be up scaled | Lamu, Tana River, Taita Taveta, Isiolo, Wajir, western kenya |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists with no commercial orientation • Limited resources • High illiteracy levels • Inadequate animal numbers • Inadequate awareness of benefits of the breed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling beef production infrastructure in ASALs • Enhance dissemination of the beef technology |


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| | <ul style="list-style-type: none"> • Transformation of pastoralism to agribusiness and contract farming. • Promote farmers field schools and adult education. • Multiply the breed • Register the breed to increase its value • Create awareness of the breed to increase adoption |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • There is inadequate knowledge on the breed • The breed growth rate is high • Highly resilient breed under harsh climatic conditions |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Market intervention to promote sale on live weight basis • Disease free zones/ Disease control zones, to widen the Market of beef cattle especially the export market • Improve the market infrastructure • Formalization of cross border trade on meat • Reduce GHGs emissions • Strategic feed reserves and seed systems in the ASALs. • Some communities are have preference for a particular colour of the animal since they think it contributes to its value |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Bulls and heifer cost KES 50.000 |
| Estimated returns | Improved Orma heifer and bulls KSH. 100,000 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • All gender will be able to benefit. • The breed may enable women and women headed household to keep livestock because of low disease incidence and maintenance costs • Need to plan for feed reserves to minimize movement of home herds that may disadvantage women , children and the youth who take care of the herds |
| Gender related opportunities | All gender can multiply the breed as a business besides sale of milk |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Mechanization of milking may enable VMGs to adopt the technology. • Fast growing steers, bulls and heifers is good business opportunity for VMG. |
| VMG related opportunities | <ul style="list-style-type: none"> • VMGs can produce the bulls, steers and heifers as a business • Steers could be finished in feedlot system. |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • Tana River County pastoralists have kept the Orma Boran for many years with minimal trypanosomosis loses |
| Application guidelines for users | <ul style="list-style-type: none"> • Obtain female Orma Boran and feed the animal well. • Introduce an Orma Boran bull or use Orma Boran semen to inseminate. |

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| | Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | Requires further research |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

GAPS

1. Inadequate knowledge on mode of tolerance and potential opportunities for scientific manipulations
2. Inadequate numbers of the breed
3. Limited numbers to allow effective selection for traits of interest (beef or dual purpose)
4. Lack of breed descriptors and registration
5. Need to determine breed productivity
6. The greenhouse gas production of the breed using different feeds and in different ecological zones

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| 2.1.6 TIMP Name | Small East African Zebu (SEAZ) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity of indigenous cattle breeds in the ASALs due to drought, diseases and pests |
| What is it? (TIMP description) | The SEAZ is a dual-purpose indigenous breed which though small, is hardy, disease and pest tolerant. It is climate smart animal that its productivity could be improved with modern genetics. |

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| |  <p><i>Small East Africa Zebu (Rendille zebu cattle)</i></p> |
| Justification | <p>Water and feed in the ASALs is scarce especially during dry seasons and drought periods. The SEAZ is a hardy breed that is disease, pest and drought tolerant. The SEAZ can walk long distances to access water and feed. It tolerates high temperatures and water stress as it is watered twice in a week during drought periods and produces beef and milk under low quality natural pastures.</p> |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | <p>Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers, Extension service providers and Researchers</p> |
| Approaches to be used in dissemination | <p>Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums.</p> |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Selection and improvement of the breed and its multiplication • Availability of the breed • Registration of the breed. • Availability of adequate feeds • High demand for milk and meat |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Ranchers - for breed multiplication • County Government - to support farmers in the uptake of the technology • NGOs - to support farmers in the uptake of the technology • Pastoral groups - to form training platform to ease access to the technology • Kenya Livestock Marketing Council - Build farmer capacity to access the breed • KMC and red meat processors - provide beef market • ENDA and Tana and Athi River Development Authority (TARDA) - breed multiplication • KAGRC- to provide semen |
| C: Current situation and future scaling up | |

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| Counties where already promoted if any | Baringo, Lamu, Tana River, Taita Taveta, Baringo, Bomet, Elgeyo Marakwet, Kajiado, Laikipia, Machakos, Nyandarua, Nyeri, Tharaka Nithi, West Pokot, Garissa, Mandera, Wajir, Isiolo |
| Counties where TIMP will be up scaled | Baringo, Lamu, Tana River, Taita Taveta, Baringo, Bomet, Elgeyo Marakwet, Kajiado, Laikipia, Machakos, Nyandarua, Nyeri, Tharaka Nithi, West Pokot, Garissa, Mandera, Wajir, Isiolo |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited improvement of the breed • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists with no commercial orientation • Poor perception of the breed • Limited resources to improve the breed • Lack of registration of the breed • High illiteracy levels |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff • Adoption of digital platforms for dissemination of technologies • National Government invest enabling beef production infrastructure in ASALs • Enhance dissemination of the beef technology • Transformation of pastoralism to agribusiness and contract farming • Promote farmers field schools and adult education. • Multiply the breed • Register the breed to increase its value • Improve productivity, resilience and GHG emission to improve on poor perception of the breed |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • As it is currently, there breed is not appreciated • The breed has high genetic diversity which can be exploited faster with the modern breeding techniques to produce high growing and yielding animals |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • SEAZ is socially acceptable in all communities • Select animals for size and productivity to increase adoption • Create awareness of the importance of the breed in the changing climate |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Initial cost of purchasing bulls and heifers KES 50,000 |
| | Improved SEAZ KES 100,000 |
| Gender issues and concerns in development, | <ul style="list-style-type: none"> • Men and youth who are mainly involved in breed selection lack finances to buy a bull whose cost is too high |

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| dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Inadequate awareness of the existence of different breeds of beef breeds especially among women who have low literacy level, leading to relatively low adoption rates • Poor access to the other resources needed e.g. credit, • Information and awareness flow • Women and youth have limited access to beef markets technology |
| Gender related opportunities | <ul style="list-style-type: none"> • Need for alternative technologies such Artificial Insemination because of the high cost of bull • Deliberate efforts to build the capacity of women headed households as breeding in most communities is a male dominated activity • Training men, women and youth on appropriate breeding practices and on beef production as a business • Men, women and youth can take up the production of breeding bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition and increased income • Have well organized gender friendly markets and marketing systems for beef as women are more involved in milk marketing • Make credit accessible to all gender categories |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The high cost of the bull may exclude adoption by VMGs who have poor access to the resources needed e.g. credit • Limited awareness on existence of different beef breeds by VMGs • Information and awareness flow among VMGs is Slow due to their low education levels • VMGs have limited access to beef markets technology |
| VMG related opportunities | <ul style="list-style-type: none"> • The capacity of the VMGs to access and utilize beef breeding technologies should be enhanced • VMG can produce the bulls and heifers as a business • Improved breeds will lead to increased meat production hence improved household nutrition, increased income and increased involvement of men, women and youth • Have well organized VMGs friendly markets and marketing systems for bulls and beef • Make credit accessible to VMGs • Target VMGs in beef breeding upscaling activities |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> ▪ SEAZ has sustained pastoralists and agro-pastoralists for millennia throughout the entire Country. Need to improve its triple effects. |
| Application guidelines for users | <ul style="list-style-type: none"> ▪ Select cows/females in good condition and mate them with good quality bulls |


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| | <ul style="list-style-type: none"> ▪ Feed adequately breed stock with good health and husbandry management, ▪ Making sure that there is proper breeding management with no inbreeding <p>Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | Requires further research |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

GAPS

1. Limited genetic improvement of the herd
2. Lack of national SEAZ stud
3. No breeders' association
4. No breed registration
5. Determination of the productivity of the breed
6. The greenhouse gas production of the breed using different feeds and in different ecological zones


2.2 Fodder

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| 2.2.1 TIMP Name | Dual purpose sorghums (Ikinyaruka) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate availability of forage in agro pastoral and pastoral beef producing areas |
| What is it? (TIMP description) | Dual-purpose sorghum variety (Ikinyaruka) is both drought tolerant and climate smart and can be used as mitigation feed shortage strategy during dry spell. The variety gives high grain (5-7t/ha) yield and high (14-18 t/ha) forage dry matter. The variety do well in cold dry highlands, at an altitude of 1500–2000 Metres and with 650 mm annual It matures in 160 days and can grow to a height of 170–200 cm. |

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| |  <p style="text-align: center;"><i>Dual purpose sorghum – Ikinyaruka</i></p> |
| Justification | <p>Available fodders in agro pastoral and pastoral beef producing areas are unable to withstand moisture stress and dries off as soon as the dry spell sets in. Dual purpose sorghum variety (Ikinyaruka) could be an alternative fodder as it is capable of withstanding a relatively long moisture stress spell. The crop can survive dry-spell conditions then resume growth once moisture becomes available. The crop has relatively low production cost and its yield potential in agro pastoral and pastoral beef producing areas is high. The fodder is suitable for silage making and could be ensiled for dry seasons feeding. Grains could be used as livestock feed while fodder could be used as livestock feed.</p> |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | <p>Small- and large-scale beef and dairy farmers, Ranchers, Pastoral and agro- pastoral beef producers. and dairy producers, Extension service providers, Researchers</p> |
| Approaches to be used in dissemination | <p>Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums, Agricultural Innovation platforms (AIPs), digital platforms</p> |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Robust production and multiplication of the variety seeds. • Capacity building on livestock keepers on the benefits of the fodder • Capacity building on crop establishment technologies of the fodder crop in their farms |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Government to create awareness and build farmers • Universities do more research to improve the technology • Seed companies to stock quality seeds and contract farmers to multiply seeds • NGOs to create awareness and facilitate farmers capacity to access and adopt the technology • CBOs to organize farmers to adopt the technology and produce large quantities for their use and sale |
| C: Current situation and future scaling up | |

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| Counties where already promoted if any | Laikipia, Bomet, Busia, Kericho, Nakuru, Laikipia, Nyandarua, Baringo |
| Counties where TIMP will be up scaled | Lamu, Tana River, Taita Taveta, Wajir, Isiolo and Marsabit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists for fail to grow fodders as a diversification of livelihood • Limited awareness of the technology • Inadequate clean seed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling subsidies of inputs in production of sorghums • County governments to create more awareness of the technology |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Provides high biomass that is good for silage • Silage quality is better than that of maize • Highly digestible hence low GHG emission |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Attitude change on use of sorghum for livestock feeding • Need for livestock feed conservation as silage • Enhance carbon sink as growing forage • Creates competitive market for the grain and forage • Need for sensitization on sorghum as a livestock feed • Adapt/develop technologies for processing sorghum to increase its utility in the feed industry |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | <ul style="list-style-type: none"> • Estimated cost of seed production per acre, KES 28,500 • (Fertilizer, labour for planting, weeding and bird damage control) • Estimated cost of forage (silage) production per acre, KES 38,500 (Fertilizer, labour for planting, weeding and ensiling) |
| Estimated returns | <ul style="list-style-type: none"> • Estimated returns on sale of seeds per acre, KES 287, 000 • Estimated returns on sale of forage material (silage), KES 248,600 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth have limited access to land fodder cultivation than men • Inadequate clean seed of forages |

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| | <ul style="list-style-type: none"> • Women would be overworked due to drudgery associated with manual planting and seed harvesting for forage Sorghum • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird damage of forage Sorghum requires bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Most production activities (planting, bird scaring, harvesting) are done by women and children • Develop technology to reduce bird scaring labour to release women and children for other activities • Mechanize planting and harvesting to reduce women and children. labour requirement and make the technology attractive to youth. |
| Gender related opportunities | <ul style="list-style-type: none"> • Land is controlled by men and need to involve men during sensitization to avoid conflict • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • Beef will be taken to the market for increased incomes • There are affirmative action opportunities for women and youths to acquire required credit |


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| | <ul style="list-style-type: none"> • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting of forage sorghum may limit access to the VMG • VMGs have limited access to land for planting fodder • VMGs lack funds to acquire required inputs such as planting materials • VMGs have limited access to agricultural information, technology and knowledge • Slow information and awareness flow to VMGs due to low academic levels • VMGs may not be able to reach far way markets or have bargaining power • VMGs may be excluded from decision making during dissemination because of their social status • Lack of awareness by VMGs will lead to low adoption of beef fodder • Mechanization of planting and harvesting would the technology accessible to the VMG |
| VMG related opportunities | <ul style="list-style-type: none"> • Mechanize planting, weeding and harvesting forage sorghum to eliminate the associated drudgery and make the technology accessible VMGs • Ease of access to clean planting material by targeting VMGs farms for demos beef fodder • Support VMGs with resources to hire labour for fodder cultivation • Can be a business opportunity for VMGs where dried feed can be packaged in the required amounts • Livelihood improvement for VMGs through increased beef consumption and sales resulting from use of increased feeds • action opportunities for VMGs to acquire required credit |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • Forage sorghum variety has already been adopted by several farmers in Nakuru, Laikipia, Kericho, Baringo, and Kajiado amongst other counties. • The demand for the seed is high. Evidence- seeds sale records at KALRO –Lanet  |

| | <i>Ikinyaruka at farmers farm in Kericho County</i> |
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| Application guidelines for users | <ul style="list-style-type: none"> • Highland forage and dual-purpose sorghum for livestock feed and human food - P.N. Gachuki, P.M. Githui, T.A. Onyango, Kenya Agricultural Research Institute (KARI) Lanet, and Josephine Kirui, World Agroforestry Centre (ICRAF) • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1-ready for up scaling |
| G. Contacts | The Institute Director Beef Research Institute, P. O. Box 3840-20100, Nakuru Email: directorbri@kalro.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Fatuma For a, Patrick Mwangi Tura Isako, Gideon Muriithi, Kenana R, Mercy Cherop, Rose A, Rhoda A, |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, KEPHIS |

Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas
3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most areas
5. Evaluation of the fodder silage in contribution to greenhouse gas emission
6. Evaluation of improved Boran performance on poor
7. Lack of mechanization technology for farm operations


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| 2.2.2 TIMP Name | Dual purpose sorghums (E1291) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate availability of forage in agro pastoral and pastoral beef producing areas |

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| <p>What is it? (TIMP description)</p> | <p>Dual-purpose sorghum variety (E 1291) is both drought tolerant and climate smart and can be used as mitigation feed shortage strategy during dry spell. The variety gives high grain (5-6 t/ha) yield and high (14-18 t/ha) forage dry matter. The variety do well in cold dry highlands, at an altitude of 1500–2000 metres and with 650 mm annual It matures in 160 days and can grow to a height of 170–200 cm.</p>  <p style="text-align: center;"><i>Dual purpose sorghum – E1291</i></p> |
| <p>Justification</p> | <p>Available fodders in agro pastoral and pastoral beef producing areas are unable to withstand moisture stress and dries off as soon as the dry spell sets in. Dual purpose sorghum variety (E 1291) could be an alternative fodder as it is capable of withstanding a relatively long moisture stress spell. The crop can survive dry-spell conditions then resume growth once moisture becomes available. The crop has relatively low production cost and its yield potential in agro pastoral and pastoral beef producing areas is high. The fodder is suitable for silage making and could be ensiled for dry seasons feeding. Grains could be used as livestock feed while fodder could be used as livestock feed.</p> |
| <p>B: Assessment of dissemination and scaling up/out approaches</p> | |
| <p>Users of TIMP</p> | <p>Small- and large-scale beef and dairy farmers, ranchers, pastoral and agro- pastoral beef producers. and dairy producers, extension service providers, Researchers</p> |
| <p>Approaches to be used in dissemination</p> | <p>Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums, Agricultural Innovation platforms (AIPs), digital platforms</p> |
| <p>Critical/essential factors for successful promotion</p> | <ul style="list-style-type: none"> • Robust production and multiplication of the variety seeds. • Capacity building on livestock keepers on the benefits of the fodder • Capacity building on crop establishment technologies of the fodder crop in their farms |

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| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Government to create awareness and build farmers • Universities do more research to improve the technology • Seed companies to stock quality seeds and contract farmers to multiply seeds • NGOs to create awareness and facilitate farmers capacity to access and adopt the technology • CBOs to organize farmers to adopt the technology and produce large quantities for their use and sale |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Laikipia, Bomet, Busia, Kericho, Nakuru, Laikipia, Nyandarua, Baringo |
| Counties where TIMP will be up scaled | Lamu, Tana River, Taita Taveta, Wajir, Isiolo and Marsabit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists for fail to grow fodders as a diversification of livelihood • Limited awareness of the technology • Inadequate clean seed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling subsidies of inputs in production of sorghums • County governments to create more awareness of the technology |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Provides high biomass that is good for silage • Silage quality is better than that of maize • Highly digestible hence low GHG emission |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Attitude change on use of sorghum for livestock feeding • Need for livestock feed conservation as silage • Enhance carbon sink as growing forage • Creates competitive market for the grain and forage • Need for sensitization on sorghum as a livestock feed • Adapt/develop technologies for processing sorghum to increase its utility in the feed industry |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | <ul style="list-style-type: none"> • Estimated cost of seed production per acre, KES 28,500 • (Fertilizer, labour for planting, weeding and bird damage control) |


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| | <ul style="list-style-type: none"> • Estimated cost of forage (silage) production per acre, KES 38,500 (Fertilizer, labour for planting, weeding and ensiling) |
| Estimated returns | <ul style="list-style-type: none"> • Estimated returns on sale of seeds per acre, KES 287, 000 • Estimated returns on sale of forage material (silage), KES 248,600 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth have limited access to land fodder cultivation than men • Inadequate clean seed of forages • Women would be overworked due to drudgery associated with manual planting and seed harvesting for forage Sorghum • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird damage of forage Sorghum requires bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Most production activities (planting, bird scaring, harvesting) are done by women and children • Develop technology to reduce bird scaring labour to release women and children for other activities • Mechanize planting and harvesting to reduce women and children. labour requirement and make the technology attractive to youth. |
| Gender related opportunities | <ul style="list-style-type: none"> • Land is controlled by men and need to involve men during sensitization to avoid conflict • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training |

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| | <ul style="list-style-type: none"> • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • Beef will be taken to the market for increased incomes • There are affirmative action opportunities for women and youths to acquire required credit • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting of forage sorghum may limit access to the VMG • VMGs have limited access to land for planting fodder • VMGs lack funds to acquire required inputs such as planting materials • VMGs have limited access to agricultural information, technology and knowledge • Slow information and awareness flow to VMGs due to low academic levels • VMGs may not be able to reach far way markets or have bargaining power • VMGs may be excluded from decision making during dissemination because of their social status • Lack of awareness by VMGs will lead to low adoption of beef fodder • Mechanization of planting and harvesting would the technology accessible to the VMG |
| VMG related opportunities | <ul style="list-style-type: none"> • Mechanize planting, weeding and harvesting forage sorghum to eliminate the associated drudgery and make the technology accessible VMGs • Ease of access to clean planting material by targeting VMGs farms for demos beef fodder • Support VMGs with resources to hire labour for fodder cultivation • Can be a business opportunity for VMGs where dried feed can be packaged in the required amounts • Livelihood improvement for VMGs through increased beef consumption and sales resulting from use of increased feeds • action opportunities for VMGs to acquire required credit |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • Forage sorghum variety has already been adopted by several farmers in Nakuru, Laikipia, Kericho, Baringo, and Kajiado amongst other counties. • The demand for the seed is high. Evidence- seeds sale records at KALRO –Lanet |

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| |  <p style="text-align: center;"><i>Dual purpose sorghum E1291in Isiolo County</i></p> |
| Application guidelines for users | <ul style="list-style-type: none"> • Highland forage and dual-purpose sorghum for livestock feed and human food - P.N. Gachuki, P.M. Githui, T.A. Onyango, Kenya Agricultural Research Institute (KARI) Lanet, and Josephine Kirui, World Agroforestry Centre (ICRAF) • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1-ready for up scaling |
| G. Contacts | The Institute Director Beef Research Institute, P. O. Box 3840-20100, Nakuru Email: directorbri@kalro.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Fatuma Fora Patrick Mwangi Tura Isako, Gideon Muriithi, Mercy Cherop, Rose A, Rhoda A, Kenana R, |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, KEPHIS |

Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas
3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most areas
5. Evaluation of the fodder silage in contribution to greenhouse gas emission
6. Evaluation of improved Boran performance on poor
7. Lack of mechanization technology for farm operations

| 2.2.3 TIMP Name | |
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| Dual purpose sorghums (BJ 28) | |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate availability of forage in agro pastoral and pastoral beef producing areas |
| What is it? (TIMP description) | <p>Dual-purpose sorghum variety (BJ 28) is both drought tolerant and climate smart and can be used as mitigation feed shortage strategy during dry spell. The variety is early maturing (110 days), 1.0 M tall as has grain yield of 3tons per hectare and DM of 14 tonnes per hectare. The variety do well in cold dry highlands, at an altitude of 1500–2000 Metres and with 650 mm annually. It is mainly used for grain production which are used in feed formulation.</p>  <p style="text-align: center;">Variety BJ28 <i>Dual purpose sorghums (BJ 28)</i></p> |
| Justification | Available fodders in agro pastoral and pastoral beef producing areas are unable to withstand moisture stress and dries off as soon as the dry spell sets in. Dual purpose sorghum variety (BJ 28) could be an alternative fodder as it is capable of withstanding a relatively long moisture stress spell. The crop can survive dry-spell conditions then resume growth once moisture becomes available. The crop has relatively low production cost and produce large amount of grain for feed formulation in agro pastoral and pastoral beef producing areas |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale beef and dairy farmers, ranchers, pastoral and agro- pastoral beef producers. and dairy producers, extension service providers, Researchers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums, Agricultural Innovation platforms (AIPs), digital platforms |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Robust production and multiplication of the variety seeds. |

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| | <ul style="list-style-type: none"> • Capacity building on livestock keepers on the benefits of the fodder • Capacity building on crop establishment technologies of the fodder crop in their farms |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Government to create awareness and build farmers • Universities do more research to improve the technology • Seed companies to stock quality seeds and contract farmers to multiply seeds • NGOs to create awareness and facilitate farmers' capacity to access and adopt the technology • CBOs to organize farmers to adopt the technology and produce large quantities for their use and sale |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Laikipia, Bomet, Busia, Kericho, Nakuru, Laikipia, Nyandarua, Baringo |
| Counties where TIMP will be up scaled | Lamu, Tana River, Taita Taveta, Wajir, Isiolo and Marsabit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists for fail to grow fodders as a diversification of livelihood • Limited awareness of the technology • Inadequate clean seed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling subsidies of inputs in production of sorghums • County governments to create more awareness of the technology |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Provides high biomass that is good for silage • Silage quality is better than that of maize • Highly digestible hence low GHG emission |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Attitude change on use of sorghum for livestock feeding • Need for livestock feed conservation as silage • Enhance carbon sink as growing forage • Creates competitive market for the grain and forage • Need for sensitization on sorghum as a livestock feed • Adapt/develop technologies for processing sorghum to increase its utility in the feed industry |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |


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| Basic costs | <ul style="list-style-type: none"> • Estimated cost of seed production per acre, KES 28,500 • (Fertilizer, labour for planting, weeding and bird damage control) • Estimated cost of forage (silage) production per acre, KES 38,500 (Fertilizer, labour for planting, weeding and ensiling) |
| Estimated returns | <ul style="list-style-type: none"> • Estimated returns on sale of seeds per acre, KES 287, 000 • Estimated returns on sale of forage material (silage), KES 248,600 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth have limited access to land fodder cultivation than men • Inadequate clean seed of forages • Women would be overworked due to drudgery associated with manual planting and seed harvesting for forage Sorghum • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird damage of forage Sorghum requires bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Most production activities (planting, bird scaring, harvesting) are done by women and children • Develop technology to reduce bird scaring labour to release women and children for other activities • Mechanize planting and harvesting to reduce women and children. labour requirement and make the technology attractive to youth. |
| Gender related opportunities | <ul style="list-style-type: none"> • Land is controlled by men and need to involve men during sensitization to avoid conflict • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available |

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| | <ul style="list-style-type: none"> • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • Beef will be taken to the market for increased incomes • There are affirmative action opportunities for women and youths to acquire required credit • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting of forage sorghum may limit access to the VMG • VMGs have limited access to land for planting fodder • VMGs lack funds to acquire required inputs such as planting materials • VMGs have limited access to agricultural information, technology and knowledge • Slow information and awareness flow to VMGs due to low academic levels • VMGs may not be able to reach far way markets or have bargaining power • VMGs may be excluded from decision making during dissemination because of their social status • Lack of awareness by VMGs will lead to low adoption of beef fodder • Mechanization of planting and harvesting would the technology accessible to the VMG |
| VMG related opportunities | <ul style="list-style-type: none"> • Mechanize planting, weeding and harvesting forage sorghum to eliminate the associated drudgery and make the technology accessible VMGs • Ease of access to clean planting material by targeting VMGs farms for demos beef fodder • Support VMGs with resources to hire labour for fodder cultivation • Can be a business opportunity for VMGs where dried feed can be packaged in the required amounts • Livelihood improvement for VMGs through increased beef consumption and sales resulting from use of increased feeds • action opportunities for VMGs to acquire required credit |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • Forage sorghum variety has already been adopted by several farmers in Nakuru, Laikipia, Kericho, Baringo, and Kajiado amongst other counties. |

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| | <ul style="list-style-type: none"> The demand for the seed is high. Evidence- seeds sale records at KALRO –Lanet |
| Application guidelines for users | <ul style="list-style-type: none"> Highland forage and dual-purpose sorghum for livestock feed and human food - P.N. Gachuki, P.M. Githui, T.A. Onyango, Kenya Agricultural Research Institute (KARI) Lanet, and Josephine Kirui, World Agroforestry Centre (ICRAF) Tura et al. (2022) Beef Cattle Production Extension Manual Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1-ready for up scaling |
| G. Contacts | The Institute Director Beef Research Institute, P. O. Box 3840-20100, Nakuru Email: directorbri@kalro.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Fatuma Fora Patrick Mwangi Tura Isako, Gideon Muriithi, Mercy Cherop, Rose A, Rhoda A, Kenana R, |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, KEPHIS |

Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas
3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most area Evaluation of the fodder silage in contribution to greenhouse gas emission
5. Lack of mechanization technology for farm operations

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| 2.2.4 TIMP Name | Dual purpose sorghums (BM 30) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate availability of forage in agro pastoral and pastoral beef producing areas |
| What is it? (TIMP description) | <p>Dual-purpose sorghum variety (BM 30) is both drought tolerant and climate smart and can be used as mitigation feed shortage strategy during dry spell. The variety duration of maturity is 210 days, grows to a height of 2.5 M and has grain yield of 6 tons per hectare and DM of 22 tonnes per hectare. The variety do well in cold dry highlands, at an altitude of 1500–2000 metres and with 650 mm rainfall annually.</p>  <p style="text-align: center;"><i>Dual purpose sorghum – BM 30</i></p> |
| Justification | Available fodders in agro pastoral and pastoral beef producing areas are unable to withstand moisture stress and dries off as soon as the dry spell sets in. Dual purpose sorghum variety (E 1291) could be an alternative fodder as it is capable of withstanding a relatively long moisture stress spell. The crop can survive dry-spell conditions then resume growth once moisture becomes available. The crop has relatively low production cost and its yield potential in agro pastoral and pastoral beef producing areas is high. The fodder is suitable for silage making and could be ensiled for dry seasons feeding. Grains could be used as livestock feed while fodder could be used as livestock feed. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale beef and dairy farmers, ranchers, pastoral and agro- pastoral beef producers. and dairy producers, extension service providers, Researchers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, |

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| | promotion of technology park and technology shows, conferences and symposiums, Agricultural Innovation platforms (AIPs), digital platforms |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Robust production and multiplication of the variety seeds. • Capacity building on livestock keepers on the benefits of the fodder • Capacity building on crop establishment technologies of the fodder crop in their farms |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Government to create awareness and build farmers • Universities do more research to improve the technology • Seed companies to stock quality seeds and contract farmers to multiply seeds • NGOs to create awareness and facilitate farmers' capacity to access and adopt the technology • CBOs to organize farmers to adopt the technology and produce large quantities for their use and sale |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Laikipia, Bomet, Busia, Kericho, Nakuru, Laikipia, Nyandarua, Baringo |
| Counties where TIMP will be up scaled | Lamu, Tana River, Taita Taveta, Wajir, Isiolo and Marsabit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists for fail to grow fodders as a diversification of livelihood • Limited awareness of the technology • Inadequate clean seed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling subsidies of inputs in production of sorghums • County governments to create more awareness of the technology |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Provides high biomass that is good for silage • Silage quality is better than that of maize • Highly digestible hence low GHG emission |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Attitude change on use of sorghum for livestock feeding • Need for livestock feed conservation as silage • Enhance carbon sink as growing forage • Creates competitive market for the grain and forage • Need for sensitization on sorghum as a livestock feed |

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| | <ul style="list-style-type: none"> • Adapt/develop technologies for processing sorghum to increase its utility in the feed industry |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | <ul style="list-style-type: none"> • Estimated cost of seed production per acre, KES 28,500 (Fertilizer, labour for planting, weeding and bird damage control) • Estimated cost of forage (silage) production per acre, KES 38,500 (Fertilizer, labour for planting, weeding and ensiling) |
| Estimated returns | <ul style="list-style-type: none"> • Estimated returns on sale of seeds per acre, KES 287, 000 • Estimated returns on sale of forage material (silage), KES 248,600 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth have limited access to land fodder cultivation than men • Inadequate clean seed of forages • Women would be overworked due to drudgery associated with manual planting and seed harvesting for forage Sorghum • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird damage of forage Sorghum requires bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Most production activities (planting, bird scaring, harvesting) are done by women and children • Develop technology to reduce bird scaring labour to release women and children for other activities • Mechanize planting and harvesting to reduce women and children. labour requirement and make the technology attractive to youth. |
| Gender related opportunities | <ul style="list-style-type: none"> • Land is controlled by men and need to involve men during sensitization to avoid conflict • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles |

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| | <ul style="list-style-type: none"> • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • Beef will be taken to the market for increased incomes • There are affirmative action opportunities for women and youths to acquire required credit • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting of forage sorghum may limit access to the VMG • VMGs have limited access to land for planting fodder • VMGs lack funds to acquire required inputs such as planting materials • VMGs have limited access to agricultural information, technology and knowledge • Slow information and awareness flow to VMGs due to low academic levels • VMGs may not be able to reach far way markets or have bargaining power • VMGs may be excluded from decision making during dissemination because of their social status • Lack of awareness by VMGs will lead to low adoption of beef fodder • Mechanization of planting and harvesting would the technology accessible to the VMG |
| VMG related opportunities | <ul style="list-style-type: none"> • Mechanize planting, weeding and harvesting forage sorghum to eliminate the associated drudgery and make the technology accessible VMGs • Ease of access to clean planting material by targeting VMGs farms for demos beef fodder • Support VMGs with resources to hire labour for fodder cultivation • Can be a business opportunity for VMGs where dried feed can be packaged in the required amounts • Livelihood improvement for VMGs through increased beef consumption and sales resulting from use of increased feeds • action opportunities for VMGs to acquire required credit |
| E: Case studies/profiles of success stories | |

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| Success stories from previous similar projects | <ul style="list-style-type: none"> Forage sorghum variety has already been adopted by several farmers in Nakuru, Laikipia, Kericho, Baringo, and Kajiado amongst other counties. The demand for the seed is high. Evidence- seeds sale records at KALRO –Lanet |
| Application guidelines for users | <ul style="list-style-type: none"> Highland forage and dual-purpose sorghum for livestock feed and human food - P.N. Gachuki, P.M. Githui, T.A. Onyango, Kenya Agricultural Research Institute (KARI) Lanet, and Josephine Kirui, World Agroforestry Centre (ICRAF) Tura et al. (2022) Beef Cattle Production Extension Manual Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1-ready for up scaling |
| G. Contacts | The Institute Director Beef Research Institute P. O. Box 3840-20100, Nakuru Email: directorbri@kalro.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Fatuma For a, Patrick Mwangi Tura Isako, Gideon Muriithi, Kenana R, Mercy Cherop, Rose A, Rhoda A, , |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, KEPHIS |


Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas
3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most area Evaluation of the fodder silage in contribution to greenhouse gas emission
5. Lack of mechanization technology for farm operations

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| 2.2.5 TIMP Name | X - Tozi |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |

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| Problem addressed | Inadequate availability of forage (quantity and quality) in agro pastoral and pastoral beef producing areas |
| What is it? (TIMP description) | Rhodes var X-Tozi was introduced in the semi- arid Coastal lowland Kenya in the year 1984 from Sudan. It has spread to other marginal areas of Kenya such as Makueni County, Kwale, and Tana. It can grow in a wide range of soils, but prefers sandy loams of volcanic origin. Requires rainfall between 600-2000mm per year and optimum temperature range is 25-35°C. Will not grow well in shade X-tozi is a leafy perennial and grows to a height of 30 to 150cm, it is adapted to the semi-arid areas and coastal lowlands. It is high yielding (833 bales/ha) |
| Justification | Feed quantity and quality in semi-arid and arid areas limits livestock production. The ASALs are degraded and are characterized by low producing annual forages. Grazing land in beef producing areas has been reducing necessitating intensification of forage production. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large- scale ranchers, pastoral and agro-pastoral beef producers |
| Approaches to be used in dissemination | ASK and County agricultural shows, Field days, Day visits, Demonstrations, posters and leaflets, Digital platforms, Agricultural Innovation Platforms (AIPs) |
| Critical/essential factors for successful promotion | - Availability of quality seeds - Stable beef and milk prices - Functional fodder value chain for hay marketing |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Governments - create awareness of the technology • NGOs - create awareness and facilitate access to the technology and link farmers to markets • Small scale livestock producers - adopt the technologies • Seed companies - produce and market seeds • Kenya Plant Health Inspectorate Service (KEPHIS)- for seed certification and variety release |
| C: Current situation and future scaling | |
| Counties where already promoted | Laikipia, Bomet, Kajiado, Narok, Makueni, Machakos |
| Counties where TIMP will be upscaled | Lamu, Taita Taveta, Wajir, Isiolo |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Inadequate awareness |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Improve extension services • Create awareness of the varieties to go hand in hand with efforts to avail seed. |
| Lessons learned | <ul style="list-style-type: none"> • Most pastoralists and agro pastoralists are not aware of the technology |


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| | <ul style="list-style-type: none"> • There is inadequate technical capacity in the country of pasture breeders for continued technology improvement |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Most pastoralists and agro pastoralists are unaware that the grasses can be planted • Need for review of seed policy to allow exchange of seeds among farmers |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost of production per acre is KES. 50,000 |
| Estimated returns | Yields per acre 300bales@bale selling at Ks.300, return KES 90,000 Profit of Ksh.40,000 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women overworked due to drudgery associated with manual planting and seed harvesting • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Deliberate effort is needed to build the capacity of men since most of farm activities are done by women. • Men to be encouraged to participate in crop development, dissemination, adoption and scaling up • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Planting and harvesting of forage and seed is manual which is a drudgery and discourages the youth adopting the technology • The manual production activities require mechanization to reduce labour for women who have multiple household roles • Develop the fodder value chain with platforms to address lack of formal marketing channels for seed and forage |
| Gender related opportunities | <ul style="list-style-type: none"> • All gender especially youth can take up the enterprise to produce and upscale the fodder produce to improve both beef and milk production • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where seeds can be packaged in the required amounts. |

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| | <ul style="list-style-type: none"> • Daily calendars will be used for proper timing of extension and other agricultural meetings for the gender categories to attend • There are affirmative action opportunities for women and youths to acquire required credit |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Initial costs of establishment are high due to the mode of labour used which would be a challenge for VMG • Planting and harvesting of forage and seed is manual and may limit adoption by VMG • No formal marketing channels and this may discourage VMG from adopting the technology • The mechanization of production and harvesting will reduce drudgery and enable VMG to adopt the technology |
| VMG related opportunities | VMG due to their limited financial capability, if supported with resources to hire labour for development and planting can establish a business of selling the grass |
| E: Case studies/profiles of success stories | |
| Success stories | <p>Farmers in Kwale have taken up X-tozi production as a business</p>  <p>Silage making using X-Tozi</p> |
| Application guidelines for users | <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3) Requires further research) | 1. Ready for upscaling |
| G: Contacts | |
| Contacts | The Institute Director Beef Research Institute, P. O. Box 3840-20100, Nakuru Email: directorbri@kalro.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Muthiani E, Ondabu N. Muthiani, E, Tura I, Kenana R, Patrick Mwangi Gideon Muriithi, Kenana R Mercy Cherop, Rose A, Rhoda A, , |
| Partner organizations | County Governments, Ranches CBOs, University of Nairobi, Kenya Plant Health Inspectorate Service (KEPHIS) |

Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas


3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most areas
5. Evaluation of the grass silage in contribution to greenhouse gas emission
6. Lack of mechanization technology for farm operations

| 2.2.6 TIMP Name | |
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| Chloris Gayana | |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate quantity and quality feed, low forage yields and disease challenge in Napier grass which is the conventional forage and lack of drought resistance fodder varieties |
| What is it? (TIMP description) | <p>Rhodes is a perennial stoloniferous grass adapted to dry highlands and semi-arid areas, it is high yielding (300-600 bales/ha) and drought tolerant. The grass spreads quickly after establishment in the field forming good ground cover and grows to 1.5 meters tall. It is useful in cut –and- carry system and for open grazing and is very popular for hay making. There are a number of varieties but common ones are giant, Boma, Mbarara and Masaba Rhodes.</p> <div style="text-align: center;">  <p><i>Rhodes-Chloris Gayana</i></p> </div> |
| Justification | <ul style="list-style-type: none"> • Inadequate feed quantity and quality for beef production systems • Need for high yielding forages for increased beef productivity • Lack of drought resistance varieties • Lack of cold highland tolerant varieties |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small and large scale farms, ranches and ADC Farms, pastoral and agro-pastoral beef producers and other farms located in the cold highlands areas, Extension service providers, Researchers |

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| Approaches to be used in dissemination | ASK and County agricultural shows, Field days, Day visits, Demonstration plots, posters, brochures, technology parks, journal publications, conferences, symposiums and digital platforms |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Drought resistance trait in the context of climate change • Faster growth and high quality feed • Availability of good quality seed |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Government to create awareness and build farmers • Universities do more research to improve the technology • Seed companies to stock quality seeds and contract farmers to multiply seeds • NGOs to create awareness and facilitate farmers capacity to access and adopt the technology • CBOs to organize farmers to adopt the technology and produce large quantities for their use and sale |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Nakuru, Laikipia, Kericho, Baringo, Nyandarua, Kajiado, Laikipia, Bomet, Busia and Kericho |
| Counties where TIMP will be up scaled | Lamu, Tana River, Taita Taveta, Wajir, Isiolo and Marsabit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of modern beef technology • Outrageous culture to pastoralists for fail to grow fodders as a diversification of livelihood • Limited awareness of the technology • Inadequate clean seed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling subsidies of inputs in production of sorghums • County governments to create more awareness of the technology |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Provides high biomass • Highly digestible hence low GHG emission |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Need for livestock feed conservation as hay • Enhance carbon sink as growing forage • Creates competitive market for the grain and hay |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Price for of 1 bale, KES 300 |

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| | <p>Average no of bales per acre, KES 200 Production cost per acre, KES 10,000.00</p> |
| Estimated returns | <p>200x 300 = KES 60,000.00 less 10,000.00. Estimated returns = KES 50,000.00</p> |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth have limited access to land fodder cultivation than men • Inadequate clean seed of forages • Women would be overworked due to drudgery associated with manual planting and seed harvesting for forage Sorghum • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird damage of forage Sorghum requires bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Most production activities (planting, bird scaring, harvesting) are done by women and children • Develop technology to reduce bird scaring labour to release women and children for other activities • Mechanize planting and harvesting to reduce women and children. labour requirement and make the technology attractive to youth. |
| Gender related opportunities | <ul style="list-style-type: none"> • Land is controlled by men and need to involve men during sensitization to avoid conflict • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement |


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| | <ul style="list-style-type: none"> • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • Beef will be taken to the market for increased incomes • There are affirmative action opportunities for women and youths to acquire required credit • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting of forage sorghum may limit access to the VMG • VMGs have limited access to land for planting fodder • VMGs lack funds to acquire required inputs such as planting materials • VMGs have limited access to agricultural information, technology and knowledge • Slow information and awareness flow to VMGs due to low academic levels • VMGs may not be able to reach far way markets or have bargaining power • VMGs may be excluded from decision making during dissemination because of their social status • Lack of awareness by VMGs will lead to low adoption of beef fodder • Mechanization of planting and harvesting would the technology accessible to the VMG |
| VMG related opportunities | <ul style="list-style-type: none"> • Mechanize planting, weeding and harvesting forage sorghum to eliminate the associated drudgery and make the technology accessible VMGs • Ease of access to clean planting material by targeting VMGs farms for demos beef fodder • Support VMGs with resources to hire labour for fodder cultivation • Can be a business opportunity for VMGs where dried feed can be packaged in the required amounts • Livelihood improvement for VMGs through increased beef consumption and sales resulting from use of increased feeds • action opportunities for VMGs to acquire required credit |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Adopted by mall scale farmers in Nakuru, Laikipia, Kericho, Baringo, Nyandarua, Kajiado, Laikipia, Bomet, Busia and Kericho |

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| |  <p style="text-align: center;">Rhodes- Chloris Gayana in farmers field</p> |
| Application guidelines for users | <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | (1-ready for up scaling, |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Muthiani E, Ondabu N Kenana R. Tura I, , Patrick Mwangi Gideon Muriithi, Kenana R Mercy Cherop, Rose A, Rhoda A, |
| Partner organizations | County Governments, Ranches CBOs, University of Nairobi, Kenya Plant Health Inspectorate Service (KEPHIS) |

Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas
3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most areas
5. Evaluation of the grass silage in contribution to greenhouse gas emission
6. Lack of mechanization technology for farm operations


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| 2.2.7 TIMP Name | Clitoria (Clitoria ternatea) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low feed quality and limited source of proteins for livestock in coastal region. |

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| <p>What is it? (TIMP description)</p> | <p>Clitoria ternatea is perennial herbaceous forage legume. Its leaves are pinnate, bearing 5-7 elliptical, 3-5 cm long leaflets. Its Flowers and Pods are solitary or paired, deep blue or pure white and about 4 cm surface area. When harvested early while mature it has crude fiber content of 25%.</p>  <p style="text-align: center;">Clitoria (<i>Clitoria ternatea</i>)</p> |
| <p>Justification</p> | <p>Coastal region is unique ecosystem that most highland fodders do not do well in the coast belts. Therefore, it is important to develop a protein source legume and it is on this basis the clitoria was developed and upscaled.</p> |
| <p>B: Assessment of dissemination and scaling up/out approaches</p> | |
| <p>Users of TIMP</p> | <p>Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers, Extension service providers, Researchers</p> |
| <p>Approaches to be used in dissemination</p> | <p>Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums.</p> |
| <p>Critical/essential factors for successful promotion</p> | <ul style="list-style-type: none"> • Availability of seeds |
| <p>Partners/stakeholders for scaling up and their roles</p> | <ul style="list-style-type: none"> • Universities- Collaborate in technology development and capacity building for the scientists • Small- and large-scale farmers - produce and market seed and hay • County Government - build capacity of producers to adoption of the technology • NGOs - build farmers capacity to increase adoption of the technology • CBOs - organize the production for marketing • Seed companies - produce and market the seeds |
| <p>C: Current situation and future scaling up</p> | |

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| Counties where already promoted if any | Kilifi, Kwale, Lamu |
| Counties where TIMP will be up scaled | Baringo, Lamu, Tana River, Taita Taveta, Isiolo, Kajiado, Laikipia, Garissa, Wajir, Isiolo |
| Challenges in dissemination | <ul style="list-style-type: none"> • Expensive seeds • Inadequate seeds • limited land size for fodder production, preference given to food crops |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Multiply seed to increase availability and reduce costs • Train farmers on intercropping with food crops |
| Lessons learned in up scaling if any | There is need for sensitization of farmers on benefits of legumes as livestock feed |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Clitoria has been accepted as a forage in the Counties where it has been introduced • Harmonize seed regulation laws to allow for seed sharing between farmers |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost per kg KES 2500 of seed |
| Estimated returns | 300 bales per acre and selling one bale KES.500 = KES 150,000.00 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth have limited access to land fodder cultivation than men • Inadequate clean seed of forages • Women would be overworked due to drudgery associated with manual planting and seed harvesting for forage Sorghum • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird damage of forage Sorghum requires bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Most production activities (planting, bird scaring, harvesting) are done by women and children • Develop technology to reduce bird scaring labour to release women and children for other activities |

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| | <ul style="list-style-type: none"> • Mechanize planting and harvesting to reduce women and children. labour requirement and make the technology attractive to youth. • Mechanization of the production process can reduce the drudgery especially for women who have multiple household roles |
| Gender related opportunities | <ul style="list-style-type: none"> • Land is controlled by men and need to involve men during sensitization to avoid conflict • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women who have multiple household roles • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • Beef will be taken to the market for increased incomes • There are affirmative action opportunities for women and youths to acquire required credit |
| VMG issues and concerns in development, dissemination, adoption and scaling up | All the production process is manual in many areas and many need mechanization for VMG to access the technology |
| VMG related opportunities | Mechanization of the production process may increase adoption by VMGs who can produce the seed for the market as well as feed for own livestock or for sale |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Farmers have realized improved milk production in dairy cows supplemented with Clitoria in the coastal lowland |
| Application guidelines for users | <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |

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| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1.Ready for up-scaling |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email:Directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Ondabu N. Muthiani E, Tura I, Kenana R, Patrick Mwangi Gideon Muriithi, Kenana R Mercy Cherop, Rose A, Rhoda A, KALRO-Katamani - Njarui, D., Njunie, M, Beattie Jones, R. K, Keating, B. A Ondabu N. Muthiani E, Tura I, Kenana R, Patrick Mwangi Gideon Muriithi, Kenana R Mercy Cherop, Rose A, Rhoda A, KALRO |
| Partner organizations | County Governments, Ranches CBOs, University of Nairobi, Kenya Plant Health Inspectorate Service (KEPHIS) |

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| 2.2.8 TIMP Name | Sweet Potato (Wagaborige) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate availability of quality feed in agro pastoral and pastoral beef producing areas |
| What is it? (TIMP description) | Sweet potato variety Wagabolige is high yielding (tuber - 7t/ha and forage - 24 t/ha) with high (16.5%) protein rich forage. It suitable in medium highlands and can also grow in other altitudes with irrigation. It is highly palatable and best suitable for a milk replacer ingredient for calves  <p><i>Sweet Potato (Wagaborige)</i></p> |

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| Justification | Available fodders in agro pastoral and pastoral beef producing areas is a challenge both in quantity and quality. Grasses, the main feed in natural pasture have low crude protein and hence need for supplementation with high crude protein to meet animal requirements especially during dry season |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale beef and dairy farmers, ranchers, pastoral and agro- pastoral beef producers. and dairy producers, extension service providers, Researchers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Availability of sweet potato vines for planting - need for production and multiplication of the vines • Stable, reliable and stable beef and milk prices |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Governments - to create awareness of the technology • Small- and large-scale farmers - to utilize the technology • Pastoralist and agro-pastoralists - to utilize the technology • Universities- Collaborate in technology development and capacity building for the scientists |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Bomet, Narok, Nakuru |
| Counties where TIMP will be up scaled | Baringo Lamu, Tana River, Taita Taveta, Elgeyo Marakwet, Kajiado, Isiolo, Laikipia, Machakos, , West Pokot, Garissa, Mandera, Wajir |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate awareness of livestock producers • Inadequate seed |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Multiply the vines • Create awareness • Build capacity of the pastoralists and agro-pastoralists on the technology |
| Lessons learned in up scaling if any | The use of potatoes vines has been reported to increase milk yield in dairy animals and weight gain in beef. |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Sweet potatoes are socially acceptable in most communities • Change of seed policy to allow for seed sharing between farmers |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Cost of I split, KES 3 |

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| | 4000 splits for 1 acre 3x4000 = KES 12000 |
| Estimated returns | Estimated production per acre, 100000 per acre x 3 = KES 300000 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women would be overworked due to drudgery associated with manual planting and seed harvesting for the fodder • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Deliberate effort is needed to build the capacity of men since most of farm activities are done by women. • Men to be encouraged to participate in crop development, dissemination, adoption and scaling up • Mechanization of the production process may attract the youth and will reduce the amount of time women spend in looking for calf feed |
| Gender related opportunities | <ul style="list-style-type: none"> • Mechanization of planting and harvesting Sweet Potato (Wagaborige) would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • There are affirmative action opportunities for women and youths to acquire required credit • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend • All gender especially youth can take up the enterprise to produce and upscale the fodder produces to improve both beef and milk production |

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| | <ul style="list-style-type: none"> • Can provide a business opportunity for all gender if mechanized |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • It may be laborious without mechanization thus discouraging to the VMGs • Mechanization of the production process may enable the VMGs to adopt |
| VMG related opportunities | Can provide a business opportunity for VMGs if mechanized to produce, the seed and feed for the market or for own livestock |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | KALRO Lanet is producing and bulking propagation material. The varieties has been distributed to farmers in Marsabit, Isiolo, Kericho and Bomet. Farmers from other counties including Nakuru, Nyandarua, Laikipia have also accessed planting materials and have reported successful establishment of the varieties in their farms |
| Application guidelines for users | <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | Ready for up-scaling |
| G. Contacts | |
| Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Naftali Odabu Tura Isako, Elizabeth Muthiani Patrick Mwangi, Gideon Muriithi, Richard Kenana,, Mercy Cherop, Rose A, Rhoda A. |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Ranches CBOs, KEPHIS |

Research Gaps

1. Inadequate Germplasm
2. Need for performance trials in ASALS under rain fed and irrigation

| 2.2.9 TIMP Name | Brachiaria Busia Variety |
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| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Shortage of high of high yielding grass with high feed quality and Failure of imported Brachiaria varieties to produce viable seeds |
| What is it? (TIMP description) | <p>Tufted perennial Brachiaria varieties which are high yielding (up to 30 ton/ha), disease and drought tolerant and produce viable seeds for propagation. They have high crude protein (CP) levels with an average of 12%. The two local varieties (B1 and K1) developed at KALRO - Lanet produce abundant forage material and viable seeds.</p> <div data-bbox="773 762 1222 1087" data-label="Image"> </div> <p data-bbox="740 1094 1255 1125" style="text-align: center;"><i>Brachiaria variety B. brizatha var. Busia</i></p> <div data-bbox="849 1131 1159 1371" data-label="Image"> </div> <p data-bbox="760 1377 1239 1409" style="text-align: center;"><i>Bagging of brachiaria to harvest seeds</i></p> |
| Justification | Available grasses in beef production areas (ASALs) have low forage yields, are of poor quality hence the need to develop high forage yielding grass variety adaptable to semi-arid and arid areas Though the available varieties have high forage yields, they have poor germination score hence the need to develop local ecotypes capable of producing viable seeds |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale beef and dairy farmers, ranchers, pastoral and agro- pastoral beef producers. and dairy producers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer |


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| | visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Need for production and multiplication of high quality seeds • Stable, reliable and stable beef and milk prices |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Universities- Collaborate in technology development and capacity building for the scientists • County Government - to support farmers in the uptake of the technology • Non-Government Organizations (NGOs) and Community Based Organizations (CBOs) - to support farmers in the uptake of the technology • Kenya Plant Health Inspectorate Services (KEPHIS) for seed certification • Seed companies for multiplication and packaging |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Bomet, Kericho, Nakuru, Marsabit, Isiolo, Nyandarua and Laikipia |
| Counties where TIMP will be up scaled | Bomet, Tana River, Lamu, Wajir, Taita Taveta, Isiolo, Marsabit Baringo, Marakwet, Kajiado, Laikipia, Uasin Gishu, West Pokot, Garissa, Wajir |
| Challenges in dissemination | <ul style="list-style-type: none"> • Shortage of seeds and other propagation materials • Inadequate extension services • Limited dissemination channels • Limited resources |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Producing and seed bulking • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • Promote farmers field schools and adult education • County Governments support on resources |
| Lessons learned in up scaling if any | The high yielding Brachiaria species are in high demand. The production and bulking of the two release varieties will bring down the cost of imported Brachiaria grass technologies that is currently high (Kshs 5,500-8000 per kg) |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Review of seed policy to allow for exchange of seeds among farmers • Breeding climate smart pasture and fodder varieties |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | <ul style="list-style-type: none"> • Not done, the varieties are newly released and currently being tested in the field. Seed production and bulking is on-going. |

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| Estimated returns | <ul style="list-style-type: none"> • Not done |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Planting and harvesting of forage and seed is manual labour that discourages youth and men; most of the activities are done by women • Deliberate effort is needed to build the capacity of men and youth. • Men and youth to be encouraged to participate in pasture and fodder development, dissemination, adoption and scaling up |
| Gender related opportunities | <ul style="list-style-type: none"> • All gender especially youth can take up the enterprise to produce and upscale the fodder produce to improve both beef and milk production |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting may limit access to the VMG • Deliberately build the capacity of the VMGs to access the technology and adopt |
| VMG related opportunities | <ul style="list-style-type: none"> • VMGs can produce the seeds as a business • VMGs can produce the forage for increasing beef and milk production |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | KALRO Lanet is producing and bulking seeds and other propagation material. The grass has also been tested for hay making. Released local varieties has been distributed to farmers in Marsabit, Isiolo, Kericho and Bomet. Farmers from other Counties including Nakuru, Nyandarua, Laikipia have also accessed planting materials and have reported successful establishment of the varieties in their farms |
| Application guidelines for users | <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria el al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for up scaling |
| G. Contacts | |
| Contacts | Director Beef Research Institute, KALRO Lanet P.O.Box 3840-20100 Nakuru directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Naftali Odabu Ann Indetie, Tura Isako, Patrick Mwangi, Gideon Muriithi, Mercy Cherop, Richard Kenana, |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa |

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| | Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) KEPHIS |
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GAPS

1. Inadequate seed and propagation materials
2. Evaluation of the pasture in contribution to greenhouse gas emission
3. Lack of mechanization technology for farm operations especially feed harvesting

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| 2.2.10 TIMP Name | Forage Sorghum (E6518) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Inadequate availability of forage in agro pastoral and pastoral beef producing areas |
| What is it? (TIMP description) | <p>Forage sorghum variety (E 6518) is both drought tolerant and climate smart and can be used as mitigation feed shortage strategy during dry spell. The variety has high biomass production with dry matter yields ranging from 23 to 26 tons /ha. It is primarily a source of energy, with an estimated 65% total digestible nutrients (TDN); it also contains about 13% TDN of protein. When fed to ruminants as either silage or wilted green chop, it can provide up to 67% of required roughage and up to 20% of the total diet as a ground grain supplement.</p>  <p style="text-align: center;"><i>Forage Sorghum E6518</i></p> |
| Justification | Available fodders in agro pastoral and pastoral beef producing areas are unable to withstand moisture stress and dries off as soon as the dry spell sets in. Forage sorghum variety (E 6518) could be an alternative fodder as it is capable of withstanding a relatively long moisture stress spell. The crop can survive dry-spell conditions then resume growth once moisture becomes available. The crop has relatively low production cost and its yield potential in agro pastoral and pastoral beef producing areas is high. The fodder is suitable for silage making and could be ensiled for dry seasons feeding. |

| B: Assessment of dissemination and scaling up/out approaches | |
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| Users of TIMP | Small- and large-scale beef and dairy farmers, ranchers, pastoral and agro- pastoral beef producers. and dairy producers, extension service providers, Researchers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums, Agricultural Innovation platforms (AIPs), digital platforms |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Robust production and multiplication of the variety seeds. • Capacity building on livestock keepers on the benefits of the fodder • Capacity building on crop establishment technologies of the fodder crop in their farms |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Universities- Collaborate in technology development and capacity building for the scientists • County Government - To support farmers in the uptake of the technology • Non-Government Organizations (NGOs) and Community Based Organizations (CBOs) - To support farmers in the uptake of the technology • Kenya Plant Health Inspectorate Services (KEPHIS) for seed certification • Seed companies for multiplication and packaging |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Laikipia, Bomet, Busia, Kericho |
| Counties where TIMP will be up scaled | Bomet, Tana River, Lamu, Wajir, Taita Taveta, Isiolo, Marsabit |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate extension services • Limited dissemination channels • Poor infrastructure • Low adoption of the technology • Limited resources • High illiteracy levels |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Incorporating private partners in extension service • County governments to increase the extension staff. • Adoption of digital platforms for dissemination of technologies • National Government invest enabling production infrastructure in ASALs • County Governments support on resources |

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| | Promote farmers field schools and adult education. |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • The variety can survive in dry spell conditions and resumes growth once moisture becomes available. • The variety produces high biomass that produces high quality silage |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Need for attitude change on use of sorghum as livestock feed. • Breeding climate smart pasture and fodder varieties • Improve the market infrastructure. Note; no policy document available |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | <ul style="list-style-type: none"> • Estimated cost of seed production per acre, KES 28,500 • (Fertilizer, labour for planting, weeding and bird damage control) • Estimated cost of forage (silage) production per acre, KES 38,500 (Fertilizer, labour for planting, weeding and ensiling) |
| Estimated returns | <ul style="list-style-type: none"> • Estimated returns on sale of seeds per acre, KES 287, 000 • Estimated returns on sale of forage material (silage), KES 248,600 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women would be overworked due to drudgery associated with manual planting and seed harvesting for the fodder • Manual Planting and harvesting of forage and seed is tedious and discourages the youth adopting the technology • Bird scaring largely done by children and women • No formal marketing channels for seed and forage • Poor women farmers lack funds to acquire required inputs such as planting materials • Women have limited access to agricultural information, technology and knowledge • Training and extension services are not targeted to women who are disadvantaged in accessing them because of their involvement in other tasks • Deliberate effort is needed to build the capacity of men since most of farm activities are done by women. • Men to be encouraged to participate in crop development, dissemination, adoption and scaling up • Mechanization of the production process may attract the youth and will reduce the amount of time women spend in looking for calf feed |
| Gender related opportunities | <ul style="list-style-type: none"> • Develop technology to reduce bird scaring labour of forage sorghum to create time for women to do other activities and children to go to school • Mechanization of planting and harvesting forage sorghum would eliminate the drudgery associated with planting and harvesting and make the technology attractive to youth as well as reduce labour for women |


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| | <ul style="list-style-type: none"> • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Fodder provision for home herds is a women activity and need to target them during training • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement • Availability of forage has potential of increasing beef production to meet the food and nutrition security of all the gender categories in the household • There are affirmative action opportunities for women and youths to acquire required credit • Daily calendars will be used for Proper timing of extension and other agricultural meetings for the gender categories to attend • All gender especially youth can take up the enterprise to produce and upscale the fodder produce to improve both beef and milk production |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • The manual activities associated with production and harvesting may limit access to the VMG • Deliberately build the capacity of the VMGs to access the technology and adopt |
| VMG related opportunities | <ul style="list-style-type: none"> • VMGs can produce the seeds as a business • VMGs can produce the forage for increasing beef and milk production |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • Forage sorghum variety has already been adopted by several farmers in Nakuru, Laikipia, Kericho, Baringo, and Kajiado amongst other counties. • The demand for the seed is high. Evidence- seeds sale records at KALRO –Lanet  <p><i>Forage sorghum E6518 in farmers field at Bomet County</i></p> |
| Application guidelines for users | <ul style="list-style-type: none"> • Highland forage and dual-purpose sorghum for livestock feed and human food - P.N. Gachuki, P.M. Githui, T.A. Onyango, Kenya Agricultural Research Institute (KARI) |

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| | <p>Lanet, and Josephine Kirui, World Agroforestry Centre (ICRAF)</p> <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria et al. (2020) Pasture and Fodder manual |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for up scaling |
| G. Contacts | |
| Contacts | The Institute Director Beef Research Institute, P. O. Box 3840-20100 , Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Patrick Mwangi, Fatuma Fora, , Naftali Odabu Tura Isako, Gideon Muriithi.,Kenana R, Rhoda A,Cherop, M, Rose A, |
| Partner organizations | ICRISAT, Universities (University of Nairobi, Egerton), County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) KEPHIS |

Research Gaps

1. Inadequate seed
2. Lack of adequate fodder validation in the semi-arid areas, coastal semi-arid areas and oasis in the arid areas
3. Inadequate awareness of the fodder among pastoral and agro-pastoral producers leading to relatively low adoption rates
4. Lack of adaptation studies in most areas
5. Evaluation of the fodder silage in contribution to greenhouse gas emission
6. Evaluation of improved Boran performance on poor
7. Lack of mechanization technology for farm operations

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| 2.2.11 TIMP Name | Tree Lucerne |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem addressed | Low protein content in beef feed especially during the dry season |
| What is it? (TIMP description) | Tree Lucerne is an evergreen perennial legume shrub rich in crude protein (18-25%). It grows in warm attitudes and cold highlands (1500 – 2500 metres above sea level with 600 – 1600 mm annual rainfall. It can grow at a height of 3Meters, producing large |

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| | <p>biomass of herbage which can be harvested and be fed fresh or conserve as silage.</p>  |
| Justification | <p>Quality feed is a major challenge for beef in all ecological zones. The feed challenge is more severe during the dry season when most forage species dry up. Tree Lucerne is evergreen and has high protein content that can improve feed quality during this dearth period</p> |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Large- and small-scale beef producers |
| Critical/essential factors for successful promotion | Availability of adequate seed |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Small- and large-scale farmers - produce and market seed and hay • County Government - build capacity of producers to adoption of the technology • NGOs - build farmers' capacity to increase adoption of the technology • CBOs - organize the production for marketing • Seed companies - produce and market the seeds |
| C: Current situation and future scaling up | |
| Counties where already promoted, if any | Nakuru, Bomet, Nyandarua |
| Counties where TIMP will be up scaled | Lamu, Taita Taveta, Laikipia, Isiolo |
| Challenges in dissemination | Seed availability |
| Suggestions for addressing the challenges | Multiply and bulk the seeds |
| Lessons learned in up scaling, if any | Tree Lucern is an alternative source of protein especially during dry seasons when other sources are scarce |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Tree Lucerne is socially accepted as a forage in the counties where it has been introduced • Environmental friendly • Harmonize seed regulation laws to allow for seed sharing between farmers • Marketing of seeds should be formalized |

| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
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| Basic costs | Cost of a seedling is KES 50 |
| Estimated returns | determined Harvest 3times per year yield 10kgs per year DM and sale at Ksh. 500 per bale, therefore 3x500= Ksh. 1500 |
| Gender issues and concerns in development and dissemination | <ul style="list-style-type: none"> • Management guidelines on the height of the tree to be maintained to allow ease of conducting management and harvesting activities by all gender • Planting and harvesting of forage and seed is manual labour that discourages youth and men; most of the activities are done by women thus women should be targeted for training • Deliberate effort is needed to build the capacity of men and youth • Men and youth to be encouraged to participate in pasture and fodder development, dissemination, adoption and scaling up |
| Gender related opportunities | <ul style="list-style-type: none"> • The adoption of the technology saves time for women especially during the dry season since feed for calves will be readily available • Reduced cost of supplementation • Can be a business opportunity for all gender where dried feed can be packaged in the required amounts and sold as animal supplement |
| VMG issues and concerns in development, dissemination adoption and scaling up | <ul style="list-style-type: none"> • Recommendation of height management for all gender to benefit |
| VMG related opportunities | <ul style="list-style-type: none"> • Can be a business opportunity for VMGs where dried feed can be packaged and sold in the required amounts to earn income |
| E: Case studies/profiles of success stories | |
| Success stories | KALRO - O Ol Joro Orok is producing and bulking seeds and other propagation material. The fodder has been distributed to farmers in Nakuru, Nyandarua, and Laikipia amongst other counties and farmers have reported success in establishment of the fodder trees. |
| Application guidelines for users | <ul style="list-style-type: none"> • Tura et al. (2022) Beef Cattle Production Extension Manual • Kuria et al. (2020) Pasture and Fodder manual • Highland forage and dual-purpose sorghum for livestock feed and human food - P.N. Gachuki, P.M. Githui, T.A. Onyango, Kenya Agricultural Research Institute (KARI) Lanet, and Josephine Kirui, World Agroforestry Centre (ICRAF) |

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| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3) Requires further research) | 1. Ready for up scaling |
| G: Contacts | |
| Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru directorbri@karo.org Institute Director, Dairy Research Institute, P.O. BOX 25-20117 Naivasha Tel: + 020 2390930, Email: director.dri@kalro.org |
| Lead organization and scientists | KALRO- Ol Joro Orok, Naphtali Kanegeni, Tura Isako, Patrick Mwangi, Mercy Cherop, Richard Kenana, |
| Partner organizations | Universities (Egerton and Nairobi), |

GAPS

1. Inadequate Germplasm
2. Need for performance trials in ASALS under rain fed and irrigation.
3. Animal performance for animals fed tree lucern in milk production and growth performance under ASAL conditions

| 2.2.12 TIMP Name | Brachiaria Mutant Variety |
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| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem addressed | Low forage yields and need for drought tolerant Brachiaria variety with wide adaptation |
| What is it? (TIMP description) | Tufted perennial variety which is high yielding (up-to 30 ton/ha), disease and drought tolerant and produce viable seeds for propagation. it has(12%) crude protein content |
| Justification | Feed quantity and quality for beef production in semi-arid and arid areas is a challenge due to degradation and reduction in grazing land. Need to reseeding the degraded areas with high yielding forage varieties.- |
| B: Assessment of dissemination and scaling up/out approaches | |

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| Users of TIMP | Small and large scale, ranchers, pastoral and agro-pastoral beef producers, Extension service providers, Researchers |
| Approaches used in dissemination | Not disseminated |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • The certification and release by KEPHIS of the varieties • Availability of quality seed • Stable beef and milk prices • Mechanization of the production process |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • KALRO- research to have the variety released and continue improving the variety qualities • Small- and large-scale farmers - produce and market seed and hay • County Government - build capacity of producers to adoption of the technology • NGOs - build farmers capacity to increase adoption of the technology • CBOs - organize the production for marketing • Seed companies - produce and market the seeds. Kenya Plant Health Inspectorate Service (KEPHIS)- for seed certification and variety release |
| C: Current situation and future scaling up | |
| Counties where already promoted | None |
| Counties where TIMP will be upscaled | Lamu, Tana River, Taita Taveta, Baringo, Marakwet, Kajiado, Laikipia, Uasin Gishu, West Pokot, Garissa, Mandera, Wajir |
| Challenges in dissemination | The varieties are yet to be released by KEPHIS hence there is no certified seeds and only a few farmers can access tillers |
| Recommendations for addressing the challenges | Fast track the NPT and DUS for Certification and registration of the varieties to allow for seed multiplication |
| Lessons learned | The high yielding Brachiaria species is in high demand. The release of the variety will bring down the cost of the Brachiaria grass technologies that is currently high (Ksh 5,500-6000 per kg) |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Review of seed policy exchange of seeds among farmers • Availability of the seed • - A functional fodder value chain |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | <ul style="list-style-type: none"> • Variety not released |
| Estimated returns | <ul style="list-style-type: none"> • Variety not released |

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| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> Planting and harvesting of forage and seed is all manual that discourages the men and youth Planting, weeding and harvesting is done by women manually thus taking a lot of time. The manual production process may need mechanization to enable youth and men to adopt and relieve women of the associated drudgery |
| Gender related opportunities | Can be produced by household members to improve beef and milk production for own livestock and for sale |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> Planting and harvesting of forage and seed is manual which may limit access of the technology The production and harvesting processes may need to be mechanized to allow VMG to adopt the technology The initial high cost of production may require VMG to be given a start-up kit |
| VMG related opportunities | VMGs can produce seeds and hay for the market if the production and harvesting processes are mechanized |
| E: Case studies/profiles of success stories | |
| Success stories | KALRO Lanet is producing hay from the grasses and seeds for own use |
| Application guidelines for users | Plant at a seed rate of 5 kg per ha in shallow furrows 50 cm apart by drilling, cover seeds lightly with soil. Feed fresh-cut and bale or make silage |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3) Requires further research) | 3. Require further research (NPT and DUS) |
| G: Contacts | |
| Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Ann Indetie, Naftali Odabu Tura Isako Patrick Mwangi, Gideon Muriithi, Richard Kenana, Cherop M. Rose A. Fatuma Fora, Rhoda A |
| Partner organizations | International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, University of Nairobi, Kenya Plant Health Inspectorate Service (KEPHIS) |

Research Gaps

1. The variety is yet to be certified and released by KEPHIS (need NPT and DUS)
2. Inadequate seed
3. Technology need to be validated in the arid and semi-arid areas
4. Inadequate awareness of the technology in agro-pastoral and pastoral areas

2.3 Management

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| 2.3.1 TIMP Name | Use of heart girth band to estimate improved Boran and other <i>Bos indicus</i> live weight |
| Category (i.e. technology, innovation or management practice) | Innovation |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity and incomes in the ASALs due to lack of reliable methods for monitoring on-farm growth performance and weight for medicine administration and market sales. |
| What is it? (TIMP description) | Weigh-band to estimate body live weight of improved Boran and other <i>Bos indicus</i> . The weigh band could be used as alternative to weigh bridge which is not potable and readily available in beef keeping areas and at the same time is also costly, weigh-band is cheaper compared to weigh bridge and easy to use. It could be used for weighing animals to determine market price. Administer drugs and evaluate animal performance. |
| Justification | Beef cattle keepers rarely weigh their beef animals to monitor their performance and neither weigh when marketing or drug administration due to high cost of weigh bridges. Lack of information on the actual weight of the animals, negatively affect drug administration and sales. This also makes it difficult for a breeder to evaluate breed performance. Weighbridge is costly to buy and maintain and thus need for development and adoption of simple and cheap technique to weigh the animal. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers, extension service providers, researchers , Universities and Tertiary Institution |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Digital platforms, agricultural innovation platforms, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> ▪ Policy interventions to promote marketing and drug administration of livestock on live body weight basis. ▪ Pastoralists and Agro-pastoralists to join breeding association to know value of weighing in monitoring breed performance. |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> ▪ County extension officers – to create awareness on the utilization of the weigh-band |

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| | <ul style="list-style-type: none"> ▪ NGOs - support farmers in the uptake of the innovation ▪ Pastoral groups - form agricultural innovation platforms to learn use of weigh-band and benefits of weighing the animals |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Not up-scaled |
| Counties where TIMP will be up scaled | All beef producing Counties of Kenya |
| Challenges in dissemination | <ul style="list-style-type: none"> • The existing mode of marketing beef that resist weighing of the animals • Lack of a policy to enforce the use of body live-weight for beef marketing • Lack of appropriate market infrastructure |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Enact a policy to ensure beef animals are sold based on live body weight. • Beef producers capacity built on importance of mainstreaming weighing animals as good husbandry practices for marketing, drug administration and monitor herd performance |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Not up-scaled |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Policy for sale of beef cattle using live body weight • Development of functional beef markets and availability of appropriate market infrastructure • Policy to support youths, VMGs and women to involve in beef marketing and animal health service system. • Need to develop animal restraining structures in the markets to facilitate weighing |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 50,000(sell of beef steer without weighing |
| Estimated returns | KES 65,000 (30% gain when using the weigh band) |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Low literacy levels among women, men and youth beef producers may limit use of the technologies • Sale of beef cattle is a man's activity and need to deliberately target them during training of heart girth band • Women may be disadvantaged as technologies requires restraining of the animals |
| Gender related opportunities | <ul style="list-style-type: none"> • The technologies will make it easy for women, men and youth to sell beef cattle through the estimated weights |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMG may be disadvantaged as some technologies require some restraining of the animals • It will make it easy for VMG to sell as the process will be straight forward |

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| | <ul style="list-style-type: none"> • VMGs should be involved in the development and dissemination • The technology makes it possible for VMG to participate in beef marketing |
| VMG related opportunities | <ul style="list-style-type: none"> • The band will make it possible for VMG to sell livestock without being exploited |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | None |
| Application guidelines for users | <ul style="list-style-type: none"> ▪ Measure the heart girth circumference and read the measurement and equivalent conversion of the live weight <p>Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | Ready for up scaling Requires validation |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

Gaps

1. Produce/manufacture girth live-weight estimation band for *Bos Indicus*
2. Validate the use of the girth live-weight estimation band for *Bos indicus*

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| 2.3.2 TIMP Name | 50:50 Milking and Suckling Regime in Beef Cattle |
| Category (i.e. technology, innovation or management practice) | Management practice |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | High calf mortality (25-35%) due to starvation arising from competition for milk between the calf and household. |

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| What is it? (TIMP description) | Half of the udder of a lactating cow is milked while the other half is suckled by the calf for increased calf survival. Calves raised using this regime have low weaning weights but are finished at the same age as those raised on 100% suckling of the dam. This regime has reduced mortality rates below 15%. |
| Justification | Calves in the pastoral and agro-pastoral production system are faced with nutritional challenges (over harvesting of dam milk) which cause slow growth rates and high mortality rates among other factors. Calves are fed by suckling the dam but which is only allowed after the cows have been milked and enough milk for the family and market has been obtained/harvested. Often, the calves hardly get enough to meet it daily requirements and at the same time attain expected daily growth rates. Therefore, 50: 50 milking and suckling regime was developed to address the aforementioned constraints in the pastoral and agro-pastoral milk suckling regime among the cattle calves. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers, extension service providers, researchers , Universities and Tertiary Institution |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Digital platforms , agricultural innovation platforms, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Institutionalization of beef production as a business to create incentives for quality beef. • Capacity building beef farmers on value of reduced mortality and faster growth rate in cattle calves visa vis harvested milk |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County extension officers - to create awareness on the management practice • NGOs and private reactionaries - support farmers in the uptake of the management practice • Pastoral groups - form training platforms for uptake of management practice |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Not up-scaled |
| Counties where TIMP will be up scaled | All beef keeping Counties of Kenya |
| Challenges in dissemination | <ul style="list-style-type: none"> • Households which depend on all the milk for food may not be keen to adopt. • Pastoral and agro-pastoral calve milk feeding regime is deep routed. |

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| | <ul style="list-style-type: none"> Seasonal fluctuation of milk may limit the adoption of management practices. |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> Household to adopt alternative livelihoods. Capacity build pastoralists and agro-pastoralists to uptake the management practice. Adoption of milk replacers and early weaning pellets |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> Not up-scaled |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> Functional market for milk to support household and women Functional market for beef Adequate feed for the dams to produce milk sustainably |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | 5,000 for purchase of milking jars and other milking requirements |
| Estimated returns | Milk production per cow – 2 litres sold @60; KES. 120 per cow per day. If household is to take 1 litre and sell 1 litres is ksh.60x30daysx 7 months lactation= KES 12600 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> Household conflict between men who are responsible for the calves and women who control the use of milk Low literacy levels among women, men and youth beef producers may limit use of the technologies |
| Gender related opportunities | <ul style="list-style-type: none"> Improved food security because animals which were not milked will be milked with minimal effect on the calf Increase income from the sale of milk and quality beef Improved calf welfare and eventually, improved beef productivity and increased met production |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> Training of women who milk on the management practices Sensitization of men who own the calves on the advantages of the management practices |
| VMG related opportunities | <ul style="list-style-type: none"> Improved food security for VMGs because animals which were not milked will be milked with minimal effect on the calf |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> Not up-scaled. |

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| Application guidelines for users | <ul style="list-style-type: none"> • Use aluminum milking jars to milk two teats and leave the other two teats for the calf • Observe milk hygiene and often test the milk for mastitis • Treat animal with mastitis <p>Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for upscaling |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute: Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | Boran Breeders Association, Sahiwal breeders association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

Gaps

1. Packaging and dissemination of the technology
2. Test performance of calves in this management regime in pastoral and agro-pastoral production system.

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| 2.3.3 TIMP Name | Integrating beef cattle in wildlife conservancies |
| Category (i.e. technology, innovation or management practice) | Management practice |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Increased human-wildlife resource conflicts arising from human and livestock population growth |
| What is it? (TIMP description) | Pastoralists set a part of their grazing land for wildlife conservation. The land is zoned into core conservation and buffer areas. Livestock are not allowed in the core conservation area but are grazed in the buffer area during the dry season. The core conservation areas is used for tourism and ecotourism as a form of wildlife utilization to generate income for the community and County government. Appropriate range management practices that include reseeding, bush management, holistic grazing and optimal stocking rates are implemented. Beef animals bought from communities and finished in |

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| | this system and conservancy management also organizes marketing for the beef cattle during dry spell as a way to reduce mortality during such times. |
| Justification | Most of the wildlife in Kenya is outside the game parks in pastoral areas. Pastoralists have for a long time not been benefiting from the wildlife and thus consider it as a menace because of perceived competition for forage with livestock. This has resulted to a lot of conflicts between wildlife/humans/crop and livestock systems and consequently led to killing of important wildlife species depleting tourism industry. The management practices of integrating beef production and wildlife management in community wildlife Conservancy is seen as a win/win scenario for both wildlife conservation and pastoral livelihoods due to increased income from both wildlife and livestock |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Pastoralist and agro-pastoralists, ranchers, Kenya Wildlife services, Conservation NGOs and Entrepreneurs |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, Digital platforms , agricultural innovation platforms, Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> ▪ Appropriate land size of about 6000 ha or 60km² ▪ Willingness of the community to set up the conservancy ▪ A willing entrepreneur to set up tourism and ecotourism Facilities. ▪ Community and community conservancies having mutual agreement on the modality of integration ▪ Strategies for conflict resolution arising from the effects of wildlife on beef production (eg. Predation) ▪ Support by the County governments. |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> ▪ KWS- To assist in managing wildlife and related conflict ▪ Conservation NGOs- support /donor to the conservancies, ▪ Communities- supply of beef cattle, conflict resolution. ▪ Entrepreneurs – beef finishing ▪ County governments- licensing of the conservancies |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Kajiado, Samburu, Laikipia, Narok, Kwale, Taita Taveta, Garissa |
| Counties where TIMP will be up scaled | Kajiado, Laikipia, Narok, Taita Taveta, Garissa |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate community knowledge on the management practice |

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| | <ul style="list-style-type: none"> • Inadequate community technical capacity and capital to establish the conservancies • High illiteracy levels • Stringent conditions in lopsided agreements against beef producers when conservancies are set up by entrepreneurs |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Sensitize communities on the technology and its benefits • Develop models to build community capacity to establish and manage communities • Assist communities in making win/win agreements when entrepreneurs are the ones that establish the conservancies |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Community Wildlife Conservancies (CWC) or Sanctuaries provide a win/win scenario for wildlife conservation and beef production if well-structured and managed • The Conservancies lead to optimal utilization of the rangelands as well as improve household incomes and livelihoods |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Support from the community and the County government is key for success of this management system. • Development and implementation of County land use policy that support the establishment of Conservancies • Conservancy is a way of differed grazing for dry spell • Range management techniques used in conservancies will reduce range degradation |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | One bull fattened in this system is bought at KES 50,000 |
| Estimated returns | After fattening could sold at KES 80000 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Low literacy levels among women, men and youth beef producers may limit use of the technologies • Sale of beef cattle is a man's activity and need to deliberately target them during training |
| Gender related opportunities | <ul style="list-style-type: none"> • Integrating beef in Wildlife conservancies establishment leads to establishment of other enterprises e.g curio shops, market for food crops and beef; these businesses provide opportunities for men, women and the youth |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMGs should be involved in the development and dissemination |
| VMG related opportunities | <ul style="list-style-type: none"> • Integrating beef in Wildlife conservancies can provide employment opportunities for VMG • Integrating beef in Wildlife conservancies establishment leads to establishment of other enterprises e.g. curio shops, market for food crops and beef; these businesses provide opportunities for VMGs |

| E: Case studies/profiles of success stories | |
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| Success stories from previous similar projects | <ul style="list-style-type: none"> There are over 160 conservancies spread across different countries that include Samburu, Laikipia, Narok, and Kajiado that generate revenue from both wildlife and beef production |
| Application guidelines for users | <ul style="list-style-type: none"> Sensitize pastoral communities in areas with wildlife on the benefits of integrating beef in wildlife Conservancies. Link them with interested partners who can invest in establishment of a Wildlife conservancy. Let the communities set a part of land for the establishment of the wildlife conservancy. Assist the communities to enter in to win/win agreements with the partners that allow for beef production in the buffer area. <p>Further Reference: Elizabeth Muthiani, PhD thesis 2006. University of Nairobi</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for upscaling |
| G. Contacts | Director Beef Research Institute, KALRO Lanet P.O.Box 3840-20100 Nakuru directorbri@karo.org |
| Lead organization and scientists | KALRO-Beef Research Institute, Tura Isako, Mwangi Githui, Gideon Muriithi, Elizabeth Muthiani |
| Partner organizations | sahiwal Breeders Association, County Government, Universities (Egerton and Nairobi, Michigan University) International Atomic Energy Agency, Austria, Embrapa Brazil, Ranches CBOs, Kenya Animal Genetic Resources Centre (KAGRC) |

GAPs

1. Impact studies on Integrating beef and wildlife on the ecosystem
2. Performance of beef animals reared in this system *visa vis* the pastoral system
3. Evaluation of the economics of the model

| 2.3.4 TIMP Name | Beef marketing |
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| Category (i.e. technology, innovation or management practice) | Management practice |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low beef farming incomes arising from disorganised kenya beef markets that are not meeting domestic and export market specifications |

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| What is it? (TIMP description) | The National market for for beef cattle demands a well finished beef after 2½ years and weighing more than 350 kg. All animals should be free from notifiable diseases, no bruises and blemishes and not fed with growth hormones or animal products for both domestic and export markets. |
| Justification | Beef production in Kenya is done in the arid and semi- arid areas by pastoralists and agro pastoralists, mostly at subsistence level and without a target market. The beef market is stratified into different segments all of which have different requirements. Lack of market oriented focus in beef production makes it impossible for majority of producers to access certain markets. Knowledge of the different market requirements by the producers may enable market-oriented production with impact on the profitability hence livelihoods. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | <ul style="list-style-type: none"> • Small- and large-scale farmers, ranchers, pastoral and agro-pastoral beef producers |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Defining the requirement of each market segment • Enforce the policy on GAP for beef production |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • All beef value chain Actors to develop a functional beef value chain to increase efficiency Pastoralists- to uptake the technology |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Kajiado, Laikipia |
| Counties where TIMP will be up scaled | Lamu, Taita Taveta, Wajir, Isiolo, Laikipia, Kajiado |
| Challenges in dissemination | <ul style="list-style-type: none"> • Beef market cartels that may resist change • Breeding goals of keepers that not in line with market demands and requirements • Lack of producer associations to benefit from economies of scale and increase bargaining power |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Formation of value chain platforms to address issues of • cartels • Orienting keepers breeding objectives and management towards market requirements • Form beef producer associations • Explore contract beef production |

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| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Has not been up scaled |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Availability of functional markets to act as an incentive to producers • Favorable beef marketing policies to spur the growth of the value chain • Strong beef consumer organization to help develop standards and ensure their adherence |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | One steer market costs Ksh.2,500 to get to selling point approximately 10 kms away, this includes transport, transport ceess/fee, movement permit, county cess/fee and loading and unloading fee |
| Estimated returns | Approximate body live weight 350kgs and selling at@kg Ksh180 leading to income of Ksh.63,000 |
| Gender issues and concerns in development, dissemination, adoption and scaling up | Men, women and the youth should be involved in sensitization because it make it easy for each gender to sell beef as opposed to earlier model where men were the main players in beef marketing |
| Gender related opportunities | Beef marketing is appropriate as a business for men, women and the youth |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMGs should be involved in the development and dissemination • The technology makes it possible for VMG to participate in beef marketing |
| VMG related opportunities | VMGs can take beef marketing as a business |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Kajiado County who were once producing for KMC |
| Application guidelines for users | <ul style="list-style-type: none"> • Identify the target market • Establish the requirements of the target market • Align production objectives to market demands and specification <p>Further reference: Tura et al. (2022) Beef Cattle Production Extension Manual</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | 1. Ready for up scaling |
| G. Contacts | Institute Director, |

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| | <p>KALRO Arid and Range Lands Research Institute P.O. Box 12 90138 Makindu, Kenya Email: directorarlri@kalro.org</p> <p>Institute Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org</p> |
| Lead organization and scientists | <p>KALRO Gideon Muriithi and Manyeki, J.K</p> |
| Partner organizations | <p>Universities (Nairobi), Kenya Livestock Marketing Council, Counties</p> |

Research Gaps

1. Limited knowledge of producers on market demands and requirements
2. Weak policy on marketing livestock
3. Development and promotion of beef marketing systems
4. Determination of cost benefit analysis of different beef marketing systems

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| 2..3.5 TIMP Name | Silvo-pastoral system |
| Category (i.e. technology, innovation or management practice) | Management Practice |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low livestock production due to land degradation and high temperatures, lowering feed intake and suppressing animal comfort zone |
| What is it? (TIMP description) | Silvo-pastoral systems are land use practices which involve the deliberate combination of trees and animals on the same land management unit in some form of spatial arrangement or temporal sequence such that there are significant ecological and economic interactions between trees and livestock components. |
| Justification | Climate change is associated with increasing temperatures and increased draught frequency in some agro-ecological zones. Integrating trees and forage will increase range productivity besides providing natural shade to animals while feeding during the day. In addition, Silvo-pastoral systems increases carbon sequestration |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | All beef producers in rangelands |
| Approaches to be used in dissemination | Field days, Extension publications (posters, brochures and leaflets), Journal publications, , Breeders shows, Trade fairs, Exhibitions, Agricultural Society of Kenya (ASK) and County agricultural shows, Exchange tours, Pastoral Field schools, Farmer to farmer visits, |

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| | promotion of technology park and technology shows, conferences and symposiums. |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Sensitization of the Land tenure system- possible in individual or group ranches. • Water is critical for this system. Can best perform along riverine |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County government -to sensitize communities on the importance of silvo-pastoral systems • Kenya forest service – to provide planting materials • KEFRI and ICRAF – research on appropriate tree species for different ecological zones |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Kilifi County, Marsabit |
| Counties where TIMP will be up scaled | Garissa, Isiolo, Kilifi, Tana river, Lamu, Wajir |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate seedling of the appropriate tree species • Land tenure • Inadequate awareness |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Create awareness • Identify adapted multipurpose trees for the system • Sensitize communities and develop an incentive to hasten adoption |
| Lessons learned in up scaling if any | Not up scaled |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> ▪ Communal land ownership may limit adoption of the management practice. ▪ Pastoral mobility leads to tree cutting for making night enclosures |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Not determined |
| Estimated returns | Not determined |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> ▪ Trees usually belong to men and grass to women, need for proper training to avoid conflicts ▪ Low literacy levels among women, men and youth beef producers may limit use of the technologies |
| Gender related opportunities | May lead to time saving for women and girls due to easy access to feed and firewood |


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| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> ▪ May ease access to feed and firewood for VMGs besides the opportunity of planting trees as a business. |
| VMG related opportunities | <ul style="list-style-type: none"> ▪ Trees may provide fuel for domestic use or sale |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Has been done in Marsabit County in Kargi, korr and ngurunit. Here use range land trees were conserved through community initiative ie Environmental Management committee, where red paint technology to mark useful trees for community to conserve. This management system reduce the tree cutting culture among the Rendille and Ariaals communities. |
| Application guidelines for users | <ul style="list-style-type: none"> ▪ Identify the desire multipurpose tree adapted to the area. ▪ Plant the trees using the recommended guidelines. ▪ For expansive grazing areas, spacing between rows should be between 50-100 meters <p>Further reference: Ndungu et.al (2003). End of programme conference proceedings, Agricultural Research Support Programme 11</p> |
| F: Status of TIMP readiness (1-ready for up scaling, 2-requires validation; 3-requires further research) | Requires further research |
| G. Contacts | Institute Director Beef Research Institute, KALRO Lanet P.O. Box 3840-20100 Nakuru Email: directorbri@karo.org |
| Lead organization and scientists | Tura Isako and Muthiani Elizabeth |
| Partner organizations | KEFRI, ICRAF, Moi University |
| Contacts | Institute Director KALRO – VSRI, Muguga P.O. Box 32 -00902 Kikuyu, Kenya |
| Lead organization and scientists | KALRO VSRI, Nginyi J. KALRO Buchuma, Syomiti M. |
| Partner organizations | NDMA, County Governments and Dairy Cooperatives |

Research Gaps

1. Appropriate multipurpose trees for Silvo-Pastoral systems in arid and semi-arid areas
2. Evaluation of livestock performance under Silvo-Pastoral systems
3. Evaluation of range productivity under Silvo-Pastoral system in arid and semi-arid areas.

2.4 Beef Animal Health

2.4.1 Vaccines

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| 2.4.1.1 TIMP name | <i>Theileria parva</i> Marikebuni East Coast Fever (ECF) vaccine |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Loss of animals due to high mortality rates associated with East coast fever (ECF) in dairy and beef cattle reduces productivity |
| What is it? (TIMP description) | <p>This is a vaccine that confers life-long protection against ECF. It is formulated from live cocktail of <i>Theileria parva</i> Marikebuni parasites. The vaccine is used in combination with 30% oxytetracycline antibiotic to prevent parasites from causing clinical disease. The vaccine is administered by trained personnel. Animals immunized with this vaccine require minimal tick control.</p>  <p style="text-align: center;"><i>Retrieving ECF vaccine vials from a liquid nitrogen tank</i></p> |
| Justification | <p>East Coast Fever (ECF), disease is transmitted by ticks and causes high mortality and production losses in cattle. In addition, control of the tick vector through frequent acaricide application and high cost of treatment of ECF infected animals increases cost of veterinary care. The ECF vaccine confers life-long immunity in cattle thereby reducing ECF incidence and cost of acaricide application. Therefore, the vaccine improves the productivity of cattle and decreases acaricide-associated pollution of the environment as well as resistance to acaricides and residues in meat and milk.</p> |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Dairy and beef farmers, Extension agents, Service providers and Researchers |

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| Approaches to be used in dissemination | Hands on training of vaccinators, on-farm trials, field days, shows and exhibitions, mass media and digital platforms |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Availability of trained vaccinators • Sensitization of the cattle keepers about the advantages of the vaccine in controlling ECF • Production and supply of quality vaccine • Good records on vaccinated animals to avoid repeated vaccinations |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Director of Veterinary Services (DVS)- Policy and regulation • Veterinary Medicines Directorate (VMD) – registration of the vaccine • County Governments – Extension services and vaccine administration • Private veterinary professionals – Vaccine administration • Global Alliance for Livestock Vaccines and Medicine (GALVmed)- Vaccine Promotion • ILRI – research on the vaccine • NGOs and the private sector- vaccine distribution • Livestock keepers-end user |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Bomet, Kericho, Kakamega, Nyeri, Kisumu, Nyandarua, Narok, Trans Nzoia, Nandi, Uasin Gishu |
| Counties where TIMP will be up scaled | All dairy and beef producing counties |
| Challenges in dissemination | <ul style="list-style-type: none"> • Demand for the vaccine outstrips supply • Fewer number of trained vaccinators • High costs associated with overreliance on liquid nitrogen for vaccine storage • Low shelf life of vaccine at room temperature • Poor vaccine distribution network • Vaccine packaged in doses of 40 and not suitable for smallholder farmers with 3-5 animals |
| Recommendations for addressing the challenges | <ul style="list-style-type: none"> • Produce more vaccine doses to meet the demand. • Train more veterinary professionals on vaccine administration-Lobby for incorporation of ECF immunization in animal health training curriculum • Lobby for funds to install liquid nitrogen plants at the KALRO VSRI Muguga • Establish strategic regional vaccine distribution networks in other KALRO livestock institutes/centres • Sensitize cattle farmers on the availability of the vaccine through participatory approaches. • Produce and package vaccine in small dose packs of probably 5 to 10 doses. |

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| | <ul style="list-style-type: none"> • Production of promotional materials, use of media in popularizing the vaccine |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • There are better returns in vaccinate young animals which will stay longer on the farm • Screening of animals to ensure they are free from <i>Theileria parva</i> Marikebuni parasites is necessary before immunization to minimize risk of clinical disease CF • ECF record keeping is important to avoid vaccinating animals that have recovered from infection since they already have life-long immunity • Even with ECF vaccination, relaxed tick control is necessary for the control of other tickborne diseases such as anaplasmosis and babesiosis • The involvement of Counties and NGOs in training of vaccinators has assisted the uptake of ECF vaccine in the control of ECF in cattle • The active involvement of the Kenya Veterinary Board in reviewing and approving content for vaccinator training of veterinary professionals enhances success in ECF vaccinations |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Need to enhance acceptance of vaccine by beef and dairy cattle keepers • Need of policy to regulate acaricide use following ECF immunization to reduce acaricide overuse and environmental contamination • Need of policy guidelines and regulation on the use of the vaccine to avoid introducing the <i>Theileria parva</i> in areas which are free from the parasite • Need for regulation of vaccine pricing to reduce farmer exploitation |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 600 to 800 to cover for the cost of vaccinating one animal (cost of vaccine, antibiotic and vaccinator labour) |
| Estimated returns | <ul style="list-style-type: none"> • The use of ECF vaccine saves approximately 80%, of cattle from dying • 50% increase in productivity from healthy livestock • There is likelihood to cost save on acaricides • 50% increase in milk and meat safety following reduction in curative treatments given to cattle • (Immunization reduces losses of KES 9975 per cow per year) |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • ECF vaccine is administered through injections thus requiring that animals are properly restrained which may not be favourable for women. • Women have limited ability to influence decision-making in their household around vaccination and animal health |

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| | <ul style="list-style-type: none"> • Vaccinators go through 3 to 4 days training at the VSRI Muguga which may limit the number of women participants • Women have poorer access to markets than men and play a limited role in the commercialization of livestock • Women and youth have limited access to finances necessary to acquire the vaccine • Involvement of women and youth in vaccine distribution may be limited by its requirement for cold chain |
| Gender related opportunities | <ul style="list-style-type: none"> • Trained vaccinators are likely to earn an extra income by actively participating in ECF vaccination drives • Knowledgeable women and youth can enter in to the distribution chain for income generation • Organize livestock farmers into groups so that they can vaccinate their animals at the same time • ECF vaccination will enhance livestock production for better food, nutrition and incomes for households |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Limited knowledge of vaccine among VMGs who have low access to agricultural information and extension services • VMGs have limited access to credit to acquire the vaccine • Involvement of VMGs in vaccine distribution may be limited by the its cold chain requirement |
| VMG related opportunities | <ul style="list-style-type: none"> • VMGs can form common interest groups for collective access of the technology and enter in to the distribution chain for income generation • ECF vaccination will enhance livestock production for better incomes and food and nutrition security for VMGs |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • Lanet Beef Research Institute in Nakuru County has significantly reduced cattle mortalities caused by ECF by adopting the use the vaccine. • The success of the Kenya Dairy Farmers Federation (KDFF),one of the distributors of ECF vaccine has vaccinated >25,000 dairy cattle against ECF over the last 5 years • Increased demand for ECF vaccinators training at the VSRI Muguga with about 454 (15 from Uganda and 8 from Rwanda) veterinary professionals already trained to deliver ECF vaccine between 2011 and 2022 • Over 70,000 doses of vaccine sold to various counties between 2012 and 2022 |

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| Application guidelines for users | <ul style="list-style-type: none"> • Ndung'u, S.G., Wesonga, F.D., Olum, M and Maichomo, M (2016). Training manual for veterinary staff immunization against ECF. 64 pages • Vaccines for control of ECF in cattle (Brochure) • Tick control after ECF immunization (Brochure) • Important tick-borne diseases in Kenya (Poster) • East Coast Fever (Brochure) • Steps in ECF immunization and post-immunization monitoring (Brochure) |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Ready for upscaling |
| G: Contacts | |
| Contacts | The Institute Director KALRO VSRI Muguga North P.O. Box 32 -00902 Kikuyu, Kenya |
| Lead organization and scientists | KALRO VSRI Muguga, Dr. James Wanjohi, Dr Moses Olum |
| Partner organizations | GALVmed, KDFP, SIDAI, VetAID, County Governments, DVS and KEVEVAPI |

Gaps

- Evaluate the effects of relaxed acaricide recommendation on sustainable control of other tick-borne diseases e.g. Anaplasmosis, Babesiosis and Cowdriosis.
- Develop and promote small dose packs appropriate for use by smallholder dairy farmers.
- Validate and make recommendations for use of *Theileria parva* marikebuni ECF vaccine in the pastoral production systems.
- Produce a vaccine batch in response to the increased demand for this product.
- Assess development, adoption and scaling up of the technology with gender and VMGs in consideration.

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| 2.4.1.2 TIMP name | Sub-unit Contagious Bovine Pleuro-pneumonia (CBPP) vaccine |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity of beef cattle due to high incidence of Contagious Bovine Pleuro-pneumonia (CBPP) arising from poor vaccination coverage and the use of the current vaccine which is cold chain dependent. |
| What is it? (TIMP description) | This technology is a thermo-tolerant protein-based CBPP vaccine that can be kept at room temperature for 14 days. It is produced from traceable proteins extracted from mycoplasma, the causative organism, which when injected in the animal offers sufficient protection from CBPP. It is superior to existing vaccines and safe for sustainable control of CBPP in Kenya and the sub-Sahara Africa region. |

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| Justification | Contagious Bovine Pleuropneumonia is a transboundary disease that lowers productivity and restricts trade along the beef value chain in Kenya. The disease is mainly prevalent in Arid and Semi-arid areas (ASALs) which have low electricity coverage to sustain the cold chain system, on which the current vaccines are dependent. Since CBPP impacts significantly on international trade, even the use of the existing vaccine is restricted due to its lack of traceability mechanisms. In addition, the current vaccine can cause adverse reactions and can cause disease in vaccinated animals since it is not fully attenuated. The new subunit CBPP vaccine addresses these limitations in the existing vaccine by being thermo-tolerant and based on traceable protective proteins and is therefore safe for use in the sustainable control of CBPP in Kenya and the sub-Saharan Africa region. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | <ul style="list-style-type: none"> • Farmers • Pastoralists • County Governments • Researchers • Ministry of Agriculture, Livestock, Fisheries and Cooperatives (MoALFC) • Livestock Extension Providers |
| Approaches to be used in dissemination | <ul style="list-style-type: none"> • Farmer Field days • Digital platforms • Agricultural Shows and exhibitions • Print and mass media • Agricultural Innovation Platforms (AIPs) |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Selection of appropriate adjuvants for formulating the vaccine to minimize adverse reactions • Functional working relations/MOU with KEVEVAPI the veterinary vaccines commercial producer • Incorporation of animal health product regulators (VMD, DVS, NACOSTI, the Kenya Veterinary Board (KVB) into the vaccine development and commercialization process • Registration and patenting of the vaccine |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Extension Service Providers (Public and private) will offer advice and collect information on the uptake of the vaccine. They will also ensure proper use of the vaccine • County Governments- Promote and create awareness on the advantages of the vaccine • DVS and VMD-Policy and regulation on use of the vaccine • Pastoralists, farmers and farmer groups- will spread information on the vaccine and provide their livestock for vaccination • KALRO-Will train trainers and provide technical backstopping during dissemination of the vaccine • KEVEVAPI- will produce the vaccine and ensure quality assurance and distribution |

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| | <ul style="list-style-type: none"> Vaccine stockists-ensure distribution and availability of the vaccine at the point of use. |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Yet to be determined |
| Counties where TIMP will be upscaled | ASALs, CSAP Beef VC |
| Challenges in dissemination | <ul style="list-style-type: none"> Inadequate vaccine production capacity at KEVEVAPI Inadequate knowledge on the use of the vaccine Inadequate vaccine distribution network Inadequate vaccine access for individual farmers/pastoralists due to centralized CBPP vaccine use control by DVS |
| Recommendations for addressing the challenges | <ul style="list-style-type: none"> Strengthening the production capacity of KEVEVAPI by lobbying for provision of necessary infrastructure and equipment Creating awareness and promotion of the vaccine Capacity building of extension workers on the use of the vaccine Strengthen Public private partnerships for sustainable distribution of the vaccine Collaboration with County Governments to enable vaccine access Lobby for eased DVS control on CBPP vaccine Encourage formation of community pastoral/farmer groups to increase vaccine accessibility |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> Working with partners with a competitive advantage will ensure successful development and commercialization of the vaccine |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> Create awareness and promote the use of the subunit vaccine in control of CBPP Need for policy to guide the incorporation of sub-unit vaccine in CBPP control in Kenya and the region Need to register the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for marketing and use of the vaccine in Kenya and the region There is need to lobby DVS to relax the supervision of vaccinations to allow involvement of private service providers Need to align use of the subunit CBPP vaccine to government agenda of creating disease free zones |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 300 per animal per year)-2 vaccinations/year |
| Estimated returns | KES 46,300 per animal from reduction in mortality, cost of treatment and loss of draft power) |
| Gender issues and concerns in development and | <ul style="list-style-type: none"> Vaccine administration is not favourable with women who are not able to restrain the animals during injections |

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| dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women have limited ability to influence decision-making in their household around vaccination and animal health • Women and youth may also have limited access to finances to purchase vaccines • Women may not be able to attend trainings conducted away from their homes in order for them to become vaccinators • Women and youth have limited access finances necessary to acquire the vaccine • Delivery of the vaccine may require a cold chain which imparts on logistics and costs for youth and women as service providers |
| Gender related opportunities | <ul style="list-style-type: none"> • Opportunity for involvement of youth in vaccine delivery • Trained vaccinators are likely to earn an extra income by actively participating in ECF vaccination drives • Knowledgeable women and youth can enter in to the distribution chain for income generation • ECF vaccination will enhance livestock production for better food, nutrition and incomes for households |
| VMG issues and concerns in dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMGs face barriers in accessing resources such as credit to acquire vaccines • VMGs are often excluded from accessing and benefitting from technologies • Delivery of vaccines will require a cold chain which imparts on logistics and costs for VMGs as service providers |
| VMG related opportunities | <ul style="list-style-type: none"> • Opportunity for VMG involvement in vaccine distribution networks through creation of incentives • VMGs can form common interest groups for collective access of the technology and enter in to the distribution chain for income generation • ECF vaccination will enhance livestock production for better incomes and food and nutrition security for VMGs |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Yet to be documented |
| Application guidelines for users | To be developed |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Requires validation |
| G: Contacts | |
| Contacts | KALRO – VSRI, Muguga North P.O. Box 32 - 00902 Kikuyu, Kenya |
| Lead organization and scientists | KALRO-VSRI Muguga, Dr Hezron Wesonga |
| Partner organizations | KEVEVAPI, VIDO Canada, ILRI, |

Gaps

- i) Assess the effectiveness nebulization and intubation challenge models to achieve infectivity threshold for sub-unit CBPP vaccine to be declared as protective
- ii) Validate the sub-unit CBPP vaccine for its efficacy in the control of CBPP in the beef production zones
- iii) Determine the cost-benefit of the sub-unit vaccine in the control of CBPP
- i) Assess development, adoption and scaling up of the technology with gender and VMGs in consideration

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| 2.4.1.4 TIMP name | Contagious Bovine Pleuropneumonia DIVA Vaccine |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity from beef cattle due to high incidence of CBPP due to the restricted use of the current vaccine by regulatory bodies because of its traceability issues. |
| What is it? (TIMP description) | The CBPP DIVA vaccine is live attenuated vaccine (based on <i>Mycoplasma species</i> from a Tanzanian outbreak strain T1, 44 th passage (T1/44) tagged with a protein marker that is easy to detect and differentiates the vaccinated cattle from the infected ones. |
| Justification | Contagious Bovine Pleuropneumonia is a transboundary disease that lowers beef production in Kenya. The disease, due to being transboundary, has important consequences on international trade. As such detection of the disease in an area attracts trade barriers and restrictions. This is because of low CBPP vaccination coverage due to restricted use of the current vaccine by regulatory bodies because of its traceability issues. Use the current CBPP vaccine also results in international trade barriers imposition on the beef value chain since it does not allow for differentiation of CBPP vaccinates from naturally infected animals. For this reasons, CBPP vaccinated animals are not differentiated from infected animals. The CBPP DIVA vaccine is tagged with a traceable protein and addresses the limitations with the current vaccine in differentiating vaccinated from infected cattle. While offering sufficient protection. The DIVA vaccine therefore enhancing trade while ensuring increased CBPP vaccination coverage. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | <ul style="list-style-type: none"> • Farmers • Pastoralists • County Governments • Researchers |

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| | <ul style="list-style-type: none"> • Ministry of Agriculture, Livestock, Fisheries and Co-operatives (MoALFC) • Livestock Extension providers |
| Approaches to be used in dissemination | <ul style="list-style-type: none"> • Farmer Field days • Training of trainers • Digital platforms • Agricultural Shows and exhibitions • Print and mass media • Agricultural Innovation Platforms (AIPs) |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Functional working relations/MOU with KEVEVAPI the veterinary vaccines commercial producer • Incorporation of animal health product regulators (VMD, DVS, NACOSTI, the Kenya Veterinary Board (KVB) into the vaccine development and commercialization process • Registration and patenting of the DIVA vaccine • Functional and effective vaccine distribution channels |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Extension service providers (Public and private) will offer advice and collect information on the uptake of the vaccine. They will also ensure proper use of the vaccine • County Governments- promote and create awareness on the advantages of the vaccine • DVS and VMD-Policy and regulation on use of the vaccine • Pastoralists, farmers and farmer groups- will spread information on the vaccine and provide their livestock for vaccination • KALRO-Will train trainers and provide technical backstopping during dissemination of the vaccine • KEVEVAPI- will produce the vaccine and ensure quality assurance and distribution • Vaccine stockists-ensure distribution and availability of the vaccine at the point of use. |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | None |
| Counties where TIMP will be up scaled | Baringo, Garissa, Marsabit Tana River, Isiolo, Tharaka Nithi, Taita Taveta, Laikipia, Bomet, Elgeyo Marakwet and Kajiado |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate knowledge on the use of the vaccine • Inadequate vaccine distribution network • Inadequate vaccine access for individual farmers/pastoralists due to centralized CBPP vaccine use control by DVS |

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| Recommendations for addressing the challenges | <ul style="list-style-type: none"> • Creating awareness and promotion of the vaccine • Capacity building of extension workers on the use of the vaccine • Strengthen Public private partnerships for sustainable distribution of the vaccine • Lobby for eased DVS control on CBPP vaccine to allow participation of private partners in vaccine delivery • Encourage formation of community pastoral/farmer groups to increase vaccine accessibility |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Working with partners with a competitive advantage will ensure successful development and commercialization of the vaccine • Demonstration of benefits of vaccination will enhance farmer willingness to adopt the vaccine |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Acceptability of the DIVA vaccine in control of CBPP • Need for policy to guide the incorporation of DIVA vaccine in CBPP control in Kenya and the region • Need to register the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region • There is need to lobby DVS to relax the supervision of vaccinations to allow involvement of private service providers • Need to align use of the DIVA vaccine to government agenda of creating CBPP disease free zones |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Approximately KES 500 per animal per year-2 vaccinations/year |
| Estimated returns | <ul style="list-style-type: none"> • Approximately KES 46,300 per animal from reduction in mortality, cost of treatment, loss of draft power and loss of trade opportunity due to restrictions |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Limitations in information access due to gender inequalities in education • Lower participation of women in vaccine dissemination activities due to cultural barriers • Gender inequalities in resources and decision making may limit access to the vaccine • Restraining of animals during vaccination may present a challenge to women |

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| | <ul style="list-style-type: none"> • Cultural practices that limit participation of certain gender categories in various aspects beef production including vaccination and distribution of vaccines • Limited time and mobility for women to attend extension activities when there are conflicting roles |
| Gender related opportunities | <ul style="list-style-type: none"> • The use of vaccine will increase income and provide household nutrition to the benefit of all • Involvement of trained youth in vaccination for them to earn an extra income by actively participating in vaccination drives • Knowledgeable women and youth can enter in to the distribution chain for income generation |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making during dissemination of technologies • VMGs face barriers in accessing resources such as credit and information • VMGs are often excluded from accessing and benefitting from technologies • Restraining of animals during vaccination may present a challenge to VMGs • The technology is labour intensive and very technical may require VMGs to hire service providers |
| VMG related opportunities | <ul style="list-style-type: none"> • VMGs can form common interest groups for collective access of the technology and enter in to the distribution chain for income generation • Vaccine Adoption will lead to increased animals' productivity hence increased incomes and improved food and nutrition security |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Yet to be documented |
| Application guidelines for users | To be developed |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Requires validation |
| G: Contacts | |
| Contacts | Institute Director, Biotechnology Research Institute, KALRO P.O. Box 362-00902 Kikuyu email: director.biori@kalro.org |
| Lead organization and scientists | KALRO Biotechnology Research Centre, Mwirigi Martin |
| Partner organizations | DVS, County Governments |

Gaps

- i) Determine the cost-benefit of using the test in the control of vaccine

- ii) Assess development, adoption and scaling up of the technology with gender and VMGs in consideration
- iii) On farm validation of the vaccine
- iv) Develop guidelines for successful use of the vaccine

| 2.4.1.5 TIMP name | Recombinant HC58 DNA Vaccine |
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| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Productivity losses from the highly pathogenic stomach worm <i>Haemonchus contortus</i> in the high potential sheep and goat producing areas of Kenya and increased anthelmintic resistance due to misuse of anthelmintics in the control of <i>H. contortus</i> |
| What is it? (TIMP description) | This is a DNA vaccine against the <i>Hemonchus contortus</i> worms in sheep and goats. The vaccine is based on the immune-inducing cysteine protease of <i>H. contortus</i> that reduce worm burden by 47%. It is a muscular injectable vaccine requiring a primary and booster vaccination 10 days apart. |
| Justification | <i>H. contortus</i> is a highly pathogenic parasite affecting sheep, goats and cattle, causing major losses to the agricultural industry worldwide. Control costs of <i>H. contortus</i> and other nematode parasites are estimated to be over KES 600 billion (US\$5,000million) annually. Haemonchosis control is so far carried out using chemical anthelmintics and grazing management however, excessive and uncontrolled use of anthelmintic drugs have resulted to emergence of anthelmintic resistant strains of the parasite, toxic residues in the human food chain and environmental pollution. Vaccination is the ultimate, effective and sustainable strategy to controlling this parasite. The recombinant HC58 DNA vaccine has been developed but requires further field testing and up-scaling for adoption. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of the TIMP | <ul style="list-style-type: none"> • Cattle Beef keepers • DVS, • KEVEVAPI • Pan African Veterinary Vaccine Centre of African Union (AU-PANVAC) • FAO |
| Approaches to be used in dissemination | <ul style="list-style-type: none"> • On-farm demonstrations • Digital platforms • Agricultural Shows and exhibitions • Print and mass media |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Stakeholder participation especially County livestock and veterinary staff • Sustainable supply of the vaccine • Affordable vaccine |

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| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • Egerton University – Technical backstopping, training of trainers, registration of the vaccine, • KALRO – Validation of vaccine • KEVEVAPI – Production and distribution, • DVS – Policy and regulation, • VMD – Registration and certification, • Farmers- End users • County Governments – Extension and vaccine distribution • Non-Governmental Organizations (NGOs) – Promotion and users |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | <ul style="list-style-type: none"> • Inadequate capacity at KEVEVAPI to produce the vaccine • Low acceptance of a vaccine against worms • Inadequate information and guidelines on the use of the vaccine |
| Counties where TIMP will be up-scaled | <ul style="list-style-type: none"> • Need to foster partnership and building capacity of KEVEVAPI for vaccine production • Create awareness and promote the vaccine • Lobby for resources to equip KEVEVAPI for production of the vaccine • Develop user guides on vaccine use |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate capacity at KEVEVAPI to produce the vaccine • Low acceptance of a vaccine against worms • Inadequate information and guidelines on the use of the vaccine |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Need to promote acceptance of the vaccine • Need for policy to guide the incorporation of Recombinant HC58 DNA Vaccine in helminth control in sheep and goats in Kenya • Need to register the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region |
| Lessons learned in up-scaling if any | Yet to be determined |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Need to promote acceptance of the vaccine • Need for policy to guide the incorporation of Recombinant HC58 DNA Vaccine in helminth control in sheep and goats in Kenya • Need to register the vaccine with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | Not yet determined |
| Estimated returns | Not determined |

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| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Recombinant HC58 DNA vaccine is administered through injections thus requiring that animals are properly restrained which may not be favourable for women. • Cultural practices that limit participation of certain gender categories in various aspects livestock production including vaccination • Limited time and mobility for women to attend extension activities when there are conflicting roles • Women have limited ability to influence decision-making in their household around vaccination and animal health • Women and youth have limited access finances necessary to acquire the vaccine |
| Gender related opportunities | <ul style="list-style-type: none"> • Develop gender targeted information and promotional materials • Affirmative action, capacity building and provision of support to women to participate • Trained vaccinators are likely to earn an extra income by actively participating in ECF vaccination drives • Knowledgeable women and youth can enter in to the distribution chain for income generation • The use of vaccine will increase income and provide household nutrition |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Due to their social status VMGs are often excluded from decision making during dissemination of technologies • VMGs face barriers in accessing information • VMGs have limited access to credit to acquire the vaccine • The technology is labour intensive and very technical may require VMGs to hire labour as service providers |
| VMG related opportunities | <ul style="list-style-type: none"> • Capacity building and support to be provided to VMGs • Create incentives for VMG owned vaccine distribution networks • Lobby for access to credit by VMGs |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | None |
| Application guidelines for users | Not yet determined |
| F: Status of TIMP readiness (1. Ready for up-scaling; 2. Requires validation; 3. Requires further research) | Requires further research |
| G: Contacts | |
| Contacts | Egerton University P.O. Box 536 - 20115, Egerton-Njoro, KENYA |

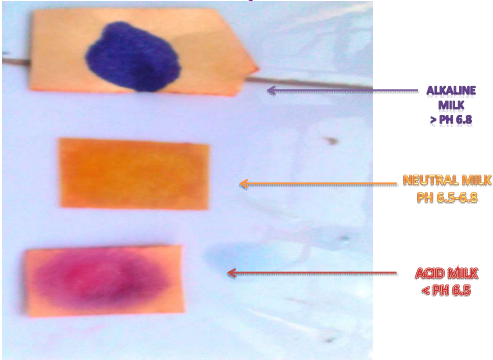
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| | Institute Director Veterinary Research Institute P.O. Box 32-00902 Kikuyu, Kenya Tel. +254-20-2524616/2519769, Tel/fax +254-20-2020512 email: director.vsri@kalro.org |
| Lead organization and scientists | Egerton University, Prof. Charles Muleke; KALRO VSRI Muguga, Dr Erick Mungube |
| Partner organizations | KEVEVAPI, DVS, AU-PANVAC, FAO |

Gaps

- i) Determine the cost-benefit of the using the vaccine
- ii) Develop guidelines for successful use of the vaccine
- iii) Assess development, adoption and scaling up of the technology with gender and VMGs in consideration
- iv) On farm validation of the vaccine

2.4.2 Diagnostic tests

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| 2.4.2.1 TIMP name | pH-based mastitis kit |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low milk production in the dairy sector from undetected prolonged mastitis infection |
| What is it? (TIMP description) | This is a rapid, farmer friendly and cost-effective kit which is used at farm level to test and detect sub-clinical mastitis in milking animals with accuracy agreement with the laboratory based tests of >95%. The kit is made from a paper strip which is impregnated with Ph indicators. The colour of the strip when dipped in milk changes on the basis of the acidity and alkalinity of milk. For mastitic milk with Ph of >6.8, the strip changes from orange to blue while in fermented milk which slightly acidic (<6.5), the strip changes from orange to pink. In normal milk with Ph of between 6.5 to 6.8, the strip remains unchanged |

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| | <p style="text-align: center;">Colour changes of pH-based milk of different pH</p>  |
| <p>Justification</p> | <p>Mastitis is an udder infection of lactating animals that reduces milk yield, changes milk composition and shortens the productive life of affected animals and as such requires rapid detection and treatment. However, this cannot be achieved with the current detection methods such as California Mastitis Test (CMT), somatic cell counts and culture which are highly technical, require trained personnel and laboratory facilities. This makes the diagnosis of mastitis expensive for smallholder dairy farmers. The use of the pH-based mastitis kit solves this problem since it ensures rapid detection and treatment of the disease and can be used by the farmer in mastitis detection. The use of the kit will enhance productivity as well contribute to food safety as milk from mastitis animals will be discarded at milking.</p> |
| <p>B: Assessment of dissemination and scaling up/out approaches</p> | |
| <p>Users of TIMP</p> | <p>Cattle and camel keepers, County veterinary and livestock staff, Private veterinary professionals, Researchers, Extension service providers</p> |
| <p>Approaches to be used in dissemination</p> | <p>Field days, agricultural shows, exhibitions, Digital platforms, Mass media, Agricultural Innovation Platforms (AIPs)</p> |
| <p>Critical/essential factors for successful promotion</p> | <ul style="list-style-type: none"> • Availability of reagents for kit production • Registration and patenting • Acceptability of the kit in mastitis detection <p style="text-align: center;">Simple for use by animal health service providers</p> |
| <p>Partners/stakeholders for scaling up and their roles</p> | <ul style="list-style-type: none"> • Farmers - End users • Dairy cooperatives- Promotion and dissemination of information • County Governments- Extension services • KALRO, Universities- Research • VMD – Registration of the strip • DVS – Regulator |
| <p>C: Current situation and future scaling up</p> | |

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| Counties where already promoted if any | Nakuru, Kajiado and Laikipia |
| Counties where TIMP will be up scaled | Counties with smallholder dairy cattle (KakamegaTaita Taveta, Nyandarua, Bomet, Kericho, Uasin Gishu, Elgeyo Marakwet, Kajiado, Nyeri Machakos, Kisumu, Siaya) Camel raising counties (Laikipia, Garissa, Marsabit, Mandera, Wajir, Tana River Isiolo), |
| Challenges in dissemination | <ul style="list-style-type: none"> • Long registration process with VMD which has delayed commercialization efforts • Patent process for the kit is long and tedious • Kit still requires proper packaging • Limited awareness about the kit |
| Recommendations for addressing the challenges | <ul style="list-style-type: none"> • Consult VMD personnel when filling the registration dossier to hasten the process • Involve the KALRO legal team to engage with KIPI to fast-track patenting process • Fast track kit packaging • Develop user information and guidelines on how it works |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • With a little training, farmer are able to conduct mastitis screening and make interpretation of the results accurately • Farmers are willing to adopt the technology • With proper training the kit can be produced with ease in any diagnostic laboratory • The kit needs to be stored in a dry and cool place away from direct sunlight • Holding of the kit with hands is likely to causes changes on the kit which may interfere with its diagnostic accuracy |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Acceptability of the use of the strip in mastitis diagnosis in all dairy production systems • Guide on proper and hygienic disposal of the used kit to minimize environmental contamination • Policy guidelines to regulate manufacture, quality and use of the strip • Need to incorporate use of kit in milk marketing • Involvement of private actors in the marketing and distribution of the kit for ease of access by dairy animal keepers • Conduct economic analysis on the use of strip kit in the diagnosis control of mastitis |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 100 per strip package of 10 |
| Estimated returns | Udders free of mastitis produce 40% more milk than mastitis affected udders. This will result in increase in amount of milk available to households for food and for sale to earn income. (KES 23000 per cow per year due to subclinical mastitis) |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Adoption of the strip kit is likely to be a challenge for women since they are not the overall decision makers at household level • Most women lack the resources with which to buy mastitis strip kit |

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| | <ul style="list-style-type: none"> • Low levels of adoption of the mastitis kit by women, most of whom are semi-illiterate • lack of adequate skills on use of the kit by women who have limited access to information and extension service |
| Gender related opportunities | <ul style="list-style-type: none"> • Use of the kit has the potential to contribute to increased milk production for food, nutrition and income security at household level • There is an opportunity to value addition and marketing following improvement in milk quality. • Women who are the involved in milking animals are likely to be main users of the technology |
| VMG issues and concerns in development, dissemination and adoption and scaling up | <ul style="list-style-type: none"> • Visually impaired persons are disadvantaged since the technology is based on colour visualization. • VMGs may lack the resources to acquire the strip kit for screening mastitis in the milking animals • Limited knowledge of KIT among VMGs who have low access to agricultural information and extension services • Due to their social status VMGs are often excluded from decision making in development and dissemination activities |
| VMG related opportunities | <ul style="list-style-type: none"> • Increased productivity of good quality presents an opportunity for VMGs to engage in milk value addition for high returns. • There is need to reach out to marginalized and vulnerable persons with animal health information as they are the least likely to access regular services • Business opportunities for VMG to sell camel milk which is popular because of its health benefits |
| E: Case studies/profiles of success stories Success stories | During field validation of the kit on Cattle in Kajiado and on camels in Laikipia, livestock keepers appreciated the simplicity with which mastitis diagnosis can be done at herd level without a need for laboratory and trained staff |
| E: Case studies/profiles of success stories | |
| Application guidelines for users | Mastitis kit user information booklet. Draft available at VSRI, Muguga |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Requires validation |
| G: Contacts | |
| Contacts | Institute Director KALRO VSRI, Muguga North P.O. Box 32 -00902 KIKUYU, Kenya |
| Lead organization and scientists | KALRO VSRI Muguga Dr Peter Ndirangu |
| Partner organizations | Veterinary Medicines Directorate (VMD), MMUST, Kibabii University, County governments and DVS |

Gap

- i) Validation of pH-based mastitis kit for detection and control of sub clinical mastitis dairy goats
- ii) Determine the cost-benefit of using the test in the control of sub-clinical mastitis in dairy animals
- iii) Develop guidelines for successful use of the test
- iv) Assess development, adoption and scaling up of the technology with gender and VMGs in consideration

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| 2.4.2.2 TIMP name | Protein tagged Latex Agglutination diagnostic test for Contagious Bovine Pleuro-Pneumonia |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity due to high incidence, high economic losses, trade restrictions and prolonged infection of beef cattle with Contagious Bovine Pleuro-pneumonia (CBPP) arising from limitations in the current laboratory based diagnostic tests. |
| What is it? (TIMP description) | This is a rapid and simple pen-side strip test embedded with a protein marker that is specific to the CBPP DIVA vaccine. The strip test forms a band when in contact with antibodies against CBPP found in exposed or vaccinated animals. The test forms a second band when in contact with antibodies specific to a protein in animals vaccinated with the CBPP DIVA vaccine thus differentiating animals vaccinated with the CBPP DIVA from infected animals. It is a field-based test that is used alongside the CBPP DIVA vaccine and suitable for use in ASALs where the CBPP is prevalent. |
| Justification | Contagious Bovine Pleuropneumonia is a transboundary disease that lowers beef productivity in Kenya. The disease, due to being transboundary, has important consequences on international trade. As such detection of the disease in an area attracts trade barriers and restrictions. Current diagnostic tests are limited in that they are laboratory based, costly, time limiting and require use of skilled personnel and equipment. In addition, they are unable to differentiate between truly infected animals from vaccinated ones. The protein tagged Latex Agglutination CBPP diagnostic test addresses the limitations of the current CBPP diagnostic tests and is important for effective and rapid detection of CBPP for decreased productivity and economic losses and reduction in trade barriers along the beef value chain. The test will support informed decision making on the use of vaccines/drugs in control of CBPP. |
| B: Assessment of dissemination and scaling up/out approaches | |

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| Users of TIMP | Pastoralists, Researchers, Beef traders associations, Beef Breeder associations, DVS, County Governments Private animal health practitioners, Extension service providers |
| Approaches to be used in dissemination | <ul style="list-style-type: none"> • Farmer Field days • On-farm demonstrations • Digital platforms • Agricultural shows and exhibitions • Print and mass media • Agricultural Innovation Platforms (AIPs) |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Availability of reagents and other consumables • Availability of effective marketing channels for the kit • Adequate infrastructural capacity to produce and supply kits |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • DVS- Policy and regulation • County Governments- End users, extension services • Private animal health practitioners-End users). • KALRO-Provide technical backstopping and training of trainers • Extension service providers (Public and private) will offer advice and collect information on the uptake of the kit. They will also ensure proper use of the kit. • County Governments- Promote and create awareness on the advantages of the kit • DVS and VMD-Policy and regulation on use of the kit • Pastoralists, farmers and farmer groups- will spread information on the use of the kit and are the end-users. • AU/PANVAC- Ensure quality assurance • Private Institutions-production, Commercialization and marketing of the kit |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | None |
| Counties where TIMP will be up scaled | Garissa, Marsabit Tana River, Isiolo, Tharaka Nithi, Taita Taveta, Laikipia, Bomet, Elgeyo Marakwet, Kajiado, |
| Challenges in dissemination | <ul style="list-style-type: none"> • Low awareness of the technology • Inadequate capacity to use the kit by extension workers and pastoralists • Lack of appropriate diagnostic kit marketing channels |
| Recommendations for addressing the challenges | <ul style="list-style-type: none"> • Promotion to raise awareness of the technology. • Capacity building of extension workers and pastoralists on use of the kit |

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| | <ul style="list-style-type: none"> • Collaboration with private institutions to enhance kit production and commercialization. |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Collaboration with partners with comparative advantages will result in successful uptake of the vaccine • Proper guideline on kit application including type and state of samples compatible with the kit will enhance its accurate use. |
| Social, environmental, policy and market conditions necessary for development and up scaling | <ul style="list-style-type: none"> • Acceptability of the kit for diagnosis of CBPP in Kenya and the sub-Saharan Africa region • Need for policy to guide the incorporation of kit in detection and control of CBPP in Kenya • Need to register the kit with the Veterinary Medicine Directorate (VMD) and other regional regulatory bodies for its use in Kenya and the region |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 20,000 per 100 tests |
| Estimated returns | Estimated KES 46,300 per animal from reduction in mortality, cost of treatment, loss of draft power and decreased market value due to CBPP infection) |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Limitations in information access due to gender inequalities in education • Gender inequalities in resources and decision making may limit access to the kit • Limited time and mobility for women to attend extension activities due to conflicting responsibilities |
| Gender related opportunities | <ul style="list-style-type: none"> • The kit is easy to use by women and youth • The use of kit will lead to increased income and provide household nutrition • Increased opportunities for youth involvement in CBPP testing and marketing of the kit |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMGs face barriers in accessing information • Due to their social status VMGs may be excluded from decision making during upscaling • VMGs face barriers in accessing resources such as credit |
| VMG related opportunities | <ul style="list-style-type: none"> • Use of the kit will benefit VMGs through increased household food and incomes for VMGs |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • None |
| Application guidelines for users | None at the moment |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Requires Validation |
| G: Contacts | |
| Contacts | Institute Director, |

| | |
|----------------------------------|---|
| | Biotechnology Research Institute, KALRO P.O. Box 362-00902 Kikuyu email: director.biori@kalro.org |
| Lead organization and scientists | KALRO Mwirigi Martin |
| Partner organizations | DVS, County Governments |

Gaps

- i) Determine the cost-benefit of using the test in the control of CBPP
- ii) Assess development, adoption and scaling up of the technology with gender and VMGs in consideration
- iii) On farm validation of the test
- iv) Develop guidelines for successful use of the test

2.4.3 Disease control strategies

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| 2.4.3.1 TIMP name | Integrated helminth control |
| Category (i.e. technology, innovation or management practice) | Management practice |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity in cattle, sheep and goats due to high helminth burden and high cost of deworming due to lack of a guideline on sustainably helminth control. |
| What is it? (TIMP description) | This is a strategy where deworming is based on the agro-ecological zone and season. In areas with two rainy seasons, four worming sessions are required. Rain is conducive for the development of helminths in the animals making them shed more eggs on pastures. Time worming to happen shortly before onset of the rains to minimize contamination of pasture with infective helminth eggs which exposes livestock to the risk of re-infection during grazing. Repeat worming should be done at the end of the rainy season so that animals enter the dry season with a less worm load. Animals in agro-ecological zones with only one rainy season, worming is done twice a year at the start and end of the rainy season. |
| Justification | Unguided use of dewormers results in high worm burden and increased cost of deworming. These reduces productivity in the red meat and dairy value chains. The use of the integrated helminth control strategy will ensure control of helminths while helping farmers save costs by only doing deworming in a justifiable manner. Routine deworming as often practiced may result in unnecessary treatments and also aid in resistance development. Milk, meat and eggs will reduced contamination with anthelmintic residues. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Dairy, beef and small ruminant farmers, Extension Service Providers, Researchers, Agrovets |

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| Approaches to be used in dissemination | Field days, shows, exhibitions, on-farm, digital platforms, innovation platforms demonstrations and posters |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Use of correct dose, dosing technique and timing. • Policy guideline on regulated use of anthelmintics • Awareness creation on integrated helminth control • Good working relationship and incorporation of DVS and County Governments in development and promotion of the strategies |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • KALRO- Research on new and alternative anthelmintic drugs, monitor resistance trends and develop resistance best-bet management options • County Governments - Extension services-dissemination of information and ensure proper use of Management practice • Private veterinarians – Clinical services • Pharmaceutical companies - Supply of anthelmintic drugs • VMD-Registration of new anthelmintic drugs before they go to the market • DVS – Regulate use of anthelmintic drugs • Livestock keepers- end users of the management practice and dissemination of information on the management practice |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Nyeri and Kericho |
| Counties where TIMP will be up scale | Baringo, Garissa, Marsabit Kakamega, Tana River, Isiolo, Tharaka Nithi, Taita Taveta, Laikipia, Nyandarua, Bomet, Kericho, Uasin Gishu, Elgeyo Marakwet, Busia, Kajiado, Nyeri Machakos, Kisumu, Siaya, West Pokot |
| Challenges in dissemination | <ul style="list-style-type: none"> • Inadequate awareness about existence of the integrated helminth control strategy • Proliferation of anthelmintic drug brands in the market some of which are counterfeits • Liberalized market for anthelmintic drugs which is hard to regulate • Under dosing since worming is based on animal live weights • Wrong timing for deworming. |
| Recommendations for addressing the challenges | <ul style="list-style-type: none"> • Create awareness about how the integrated helminth control strategy works • Enforce regulations on registration of drugs to enhance quality • Capacity build farmers and technicians on correct doses, |

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| | <ul style="list-style-type: none"> • Develop farmer-friendly guidelines on proper dosing and application of dewormers • Avail simple and easy to use weighing techniques to encourage dosing based on live weight • Ensure worming is done based on season and risk of helminth infection |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Deworming can be timed to only be done when needed • Farmers if trained can be able to estimate the weight of their animals as a guide to giving correct anthelmintic drug dosages • Application of the management practice saves unnecessary costs |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Need for policy guidelines on anthelmintic use (in view of Animal disease Act (CAP 364) as enforced by DVS) • Need for regulation on anthelmintic quality |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 100-200/dose of anthelmintic |
| Estimated returns | The adoption and use of this strategy will save up to 30% of costs incurred when routine deworming after once after 3 months |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women and youth may have challenges handling cattle and rams and bucks during worming • Women and youth are rarely involved in decision making on when and how to do worming • Women, may not access extension information and on the use of integrated helminth control strategy due to low levels of education and other cultural barriers. • Ownership of cattle and small ruminants is predominantly a preserve of men which disadvantages women and youth when it comes to decision making |
| Gender related opportunities | <ul style="list-style-type: none"> • Improved productivity of animals will lead to increased incomes for both gender and youth • The women and youth may get an opportunity to conduct capacity building as well as community extension services • The youth may be involved in generation of messages to popularize the integrated helminth control strategy within their community • Business opportunity for youth to take up animal health as a business |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMGs especially PWDs may be disadvantaged when it comes to walking long distances to seek for extension services on helminth control |

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| | <ul style="list-style-type: none"> • VMGs may lack the resources to acquire dewormers for their livestock • People with disability will be disadvantaged in restraining the animals |
| VMG related opportunities | <ul style="list-style-type: none"> • Increased incomes from savings on anthelmintic drugs for other household uses by VMGs • The VMGs may be involved in generation of messages to popularize the integrated helminth control strategy within their community |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | <ul style="list-style-type: none"> • The integrated helminth control promoted used extensively in many agro-ecological zones of Kenya by KARI-DFID (1994-2000) • The integrated helminth control strategy successfully used on dorper sheep belonging to the community sheep breeding groups in Laikipia and Kajiado Counties |
| Application guidelines for users | KARI-DFID - Integrated helminth control (Technical Note) |
| F: Status of TIMP readiness (1. Ready for up scaling; 2. Requires validation; 3. Requires further research) | Ready for up scaling |
| G: Contacts | |
| Contacts | Institute Director KALRO – VSRI, Muguga North P.O. Box 32 - 00902 Kikuyu, Kenya |
| Lead organization and scientists | KALRO VSRI Dr. Nginyi J., Dr Mungube E.O |
| Partner organizations | DVS, Pharmaceuticicals, County Governments, VMD |

Gaps

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

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| 2.4.3.2 TIMP name | Push-Pull for tsetse fly control |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Losses in cattle due to high incidence of Nagana and increased trypanocidal drug resistance |
| What is it? (TIMP description) | This technology uses attractants and repellent chemicals blends to repel tsetse flies away from |

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| | cattle or kill those that attempt to feed on cattle thus reducing transmission of trypanosomes and reducing the risk of spreading nagana. The technology optimized the response of tsetse flies to odors and can potentially augment the current tsetse fly-control interventions. |
| Justification | Over-reliance and misuse of trypanocides resulted in trypanocidal drug resistance and high incidence of Nagana and reduced cattle productivity in tsetse infested areas. The use of push-pull enables farmers to keep productive cattle in high tsetse infested areas thereby enhancing the productivity of cattle. Push-pull will contribute to building the resilience by ensuring trypano-susceptible cattle breeds survive, reproduce and produce in high tsetse challenge areas |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Livestock farmers, Extension service providers, Researchers, NGOs and CBOs, Agrovets |
| Approaches to be used in dissemination | Field days, on-farm demonstrations, ASKs shows, exhibitions and farmer outreach activities |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Availability of effective repellants and attractants • Training on how to use repellants and attractants on cattle • Extensively promote the use of push-pull in controlling nagana • Ensure full involvement of the pastoralists and stakeholders in the Camel milk and meat value chain • To avoid counterfeiting, encourage the registration on all chemicals used as repellants and attractants by VMD • Involve DVS for enforcing regulated use of the repellants and attractants |
| Partners/stakeholders for scaling up | <ul style="list-style-type: none"> • Kenya Tsetse and Trypanosmiasis Eradication Council (KenTTEC) - Surveillance of Tsetse fly and nagana • KALRO – Research on tsetse and nagana control • Universities - Research on tsetse and nagana control • DVS – Policy regulations on tsetse and nagana control • Bio-innovate- Funding agency • County Governments - Extension services |

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| | <ul style="list-style-type: none"> • Cattle keepers-end users of the technology and disseminators of information on its use |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Kwale |
| Counties where TIMP will be up scaled | Tana River, Isiolo, Busia, Bungoma, Kirinyaga, Kajiado, Meru, Homabay, Kisumu, Siaya, Meru |
| Challenges in dissemination | <ul style="list-style-type: none"> • The repellants and attractants not packaged in form for direct use by farmers • Production repellants and attractants is still at pre-industrial level • Low awareness levels on existence and use of the push-pull technology |
| Suggestions for addressing the challenges | <ul style="list-style-type: none"> • Package repellants in a form that can easily be used by farmers • Fast track patenting, registration and commercialization of repellants and attractants • Sensitize farmers and other stakeholders on the availability of repellants and attractants for controlling tsetse flies |
| Lessons learned in up scaling if any | <ul style="list-style-type: none"> • Proper use of push-pull technology helps to sustainably and cost-effectively control nagana in cattle reared in high tsetse challenge areas • Repellants and attractants should not be diluted before applying to cattle • There is need to involve cattle keepers when using the technology • Enhancing the capacity of cattle keepers improves the effectiveness of the push pull technology • Always remind farmers not to spray animals applied with attractants and repellants |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Acceptability of the technology among livestock keepers • Guidelines on use of attractants and repellants to prevent pollution of the environment especially water masses if not properly done • Policy on quality control of insecticides |
| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 300/animal per week for treatment with an attractant/repellent |
| Estimated returns | The spray will prevent 30% loss in cattle herds due to nagana |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Women may have challenges handling and applying the repellants and attractants onto cattle |


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| | <ul style="list-style-type: none"> • Women are rarely involved in decision making on when and how to use repellants and attractants • Women may not be able access extension messages and on push-pull of education and other cultural barriers. • Ownership of cattle is predominantly a preserve of men which disadvantages women and youth when it comes to decision making |
| Gender related opportunities | Youth may train to use push-pull and earn some income from practicing it by acting as distributors and service providers |
| VMG issues and concerns in development , dissemination, adoption and scaling up | <ul style="list-style-type: none"> • VMGs may lack resources to procure and use attractants • VMGs may be disadvantaged in terms accessing extension material and other dissemination information on the technology • VMGs with health challenges may be affected by chemicals used in the formulation of the attractants and repellants • Persons with visual impairment may face challenges reading and internalizing manufacturer instructions handling and how to use the attractants and repellants |
| VMG related opportunities | VMGs may train to use push-pull and earn some income from practicing it by acting as distributors and service providers |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | The push-pull technology used on experimental farms in Kwale with 98% protection success on preventing nagana infection in experimental |
| Application guidelines for users | Mieji, P.O. et al., 2022. Perspectives on Odor-Based Control of Tsetse Flies in Africa. <i>Frontiers in Physiology</i> , DOI - 10.3389/fphys.2022.831618 |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Requires field validation |
| G: Contacts | |
| Contacts | Institute Director, KALRO Biotechnology Research Institute Muguga P.O. Box 362 -00902 Kikuyu |
| Lead organization and scientists | KALRO Biotechnology Research Institute, Muguga- Dr Paul Mreji |
| Partner organizations | Kenya Tsetse and Trypanosmiasis Eradication (KenTTEC), Council, Kenyatta University, |

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| | DVS, Bioinnovate, Gulu University, County Governments |
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General Research Gaps push pull TIMP

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

2.4.4 Medicated feed supplements

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| 2.4.4.1 TIMP name | Medicated Molasses Urea Mineral Block (MMUMB) |
| Category (i.e. technology, innovation or management practice) | Technology |
| A: Description of the technology, innovation or management practice | |
| Problem to be addressed | Low productivity in cattle, sheep and goats due to fluctuating quality and quantity of feed during periods of drought and high worm burden. |
| What is it? (TIMP description) | Medicated MUMB is a composite feed supplement made from molasses, urea and mineral premixes infused with a dewormer for the control of chronic worm infections especially in lactating cattle, calves, sheep and goats.  <i>MMUMB block</i> |
| Justification | Feeds in the ASALs are of low quality and chronic worm infections are quite prevalent in these areas. This results in low weight gain and high mortality in cattle, sheep and goats. MMUMBs are a cheap alternative to commercial supplements and are a source of nitrogen and energy during drought. The medicated type is useful in reducing the worm burden. |
| B: Assessment of dissemination and scaling up/out approaches | |
| Users of TIMP | Dairy and meat farmers/pastoralists, Extension service providers, Researchers, Agrovets |

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| Approaches to be used in dissemination | On-farm demonstrations, field days, shows and exhibitions, print media, mass media, digital platforms |
| Critical/essential factors for successful promotion | <ul style="list-style-type: none"> • Sensitization on availability and benefits of the blocks • Availability of raw materials for making blocks • Availability of distribution and marketing channels |
| Partners/stakeholders for scaling up and their roles | <ul style="list-style-type: none"> • County Governments (end users) , • farmer groups (end users), • National Drought Management Authority (NDMA) (end users) • KALRO (Research and technical backstopping) • Private Institutions (Marketing of the blocks) |
| C: Current situation and future scaling up | |
| Counties where already promoted if any | Nyanza, Nyandarua, Kisumu, Nandi, Garissa, wajir, Taita Taveta, Makueni |
| Counties where TIMP will be up scaled | Baringo, Garissa, Marsabit Kakamega, Tana River, Isiolo, Tharaka Nithi, Taita Taveta, Laikipia, Nyandarua, Bomet, Kericho, Uasin Gishu, Elgeyo Marakwet, Busia, Kajiado, Nyeri Machakos, Kisumu, Siaya, West Pokot |
| Challenges in dissemination | <ul style="list-style-type: none"> • Technology is available but requires refinement and funding to produce the blocks for dissemination. • Presentation and packaging of the block. • Lack of appropriate marketing channels for the blocks |
| Recommendations for addressing the challenges | <ul style="list-style-type: none"> • Improve the MMUMB packaging. • Further refinement to improve on appearance and the state of the product. • Preparation of product in pellet form • Partnership with private institutions to market the blocks |
| Lessons learned in up scaling if any | MUMBs are highly palatable and require close supervision to avoid continuous licking as this can cause urea poisoning. They are more desired during periods of drought. |
| Social, environmental, policy and market conditions necessary | <ul style="list-style-type: none"> • Incorporation of blocks in utilization of blocks in national drought management programme • Awareness of availability of the technology • Kenya Bureau of Standards (KEBS) certification • Guidelines on use of blocks in cattle finishing programmes in ASALs |

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| D: Economic, gender, vulnerable and marginalized groups (VMGs) considerations | |
| Basic costs | KES 80 - 100 per kg |
| Estimated returns | KES 30 - 50 per kg (Beef ration consisting MUMMBs and Effel grass of 161-260g/day body weight gain, This enables completion of beef finishing in 6 months. Using this ration it is possible to reduce duration of finishing an animal from birth to market weight of 250 kg from 4 years to 2 years. Thereby making 50% saving on feed, labour and veterinary care |
| Gender issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Gender bias in access to resources by women and youth may limit their access to MMUMBs • Conflicting household roles may limit participation of women in dissemination activities • Educational barriers may limit women from accessing information on the use of MMUMBs |
| Gender related opportunities | <ul style="list-style-type: none"> • Production and sale of MMUMBs can be done by all gender but is an employment creation opportunity that can benefit women and youth • Use of MMUMBs increases household income and nutrition to the benefit of all gender |
| VMG issues and concerns in development, dissemination, adoption and scaling up | <ul style="list-style-type: none"> • Social barriers could limited participation of VMGs in decision making involving the use of MMUMBs • VMGs could face barriers in accessing information • VMGs face barriers in benefitting from production and commercialization of this technology |
| VMG related opportunities | <ul style="list-style-type: none"> • Opportunity for VMGs to access incentivized benefit from production and sale of MMUMBs • Capacity building opportunity for VMGs through training in MMUMB production |
| E: Case studies/profiles of success stories | |
| Success stories from previous similar projects | Mass purchases for drought mitigation by NDMA, Kasaku farmer group in Nyandarua, Shiners farmers group Nakuru indicating potential demand for the technology, |
| Application guidelines for users | Use of MMUMB as a feed supplement (Brochure) |
| F: Status of TIMP readiness (1. Ready for upscaling; 2. Requires validation; 3. Requires further research) | Ready for up scaling |
| G: Contacts | |
| Contacts | Institute Director KALRO – VSRI, Muguga P.O. Box 32 -00902 Kikuyu, Kenya |

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| Lead organization and scientists | KALRO VSRI, Nginyi J. KALRO Buchuma, Syomiti M. |
| Partner organizations | NDMA, County Governments and Dairy Cooperatives |

Research Gaps

- Diversify the formulations of the MMUMBs to include pelleting for ease of use on animals of different age categories.
- Mechanize the MMUMBs production process to ensure standardized product.
- Assess development, adoption and scaling up of the technology with gender and VMGs in consideration.



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