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ARLRI Kiboko

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Overview

About the Institute	**Historical Background** KALRO - Kiboko Research Centre was established in 1969 as a research station charged with the responsibility of undertaking national range research which entailed undertaking work on applied research on specific constraints affecting rangeland productivity and eventually develop appropriate technologies, recommendations, techniques, and knowledge system that would solve/mitigate production set-backs. That involved research in range management, range utilization and improvement of rangelands for increased livestock productivity on sustainable basis. In 1989 the station joined the then Kenya Agricultural Research Institute (KARI) from Scientific Research division (SRD) under MoA&LD and continued with its assigned mandate of range research in the southern rangelands with semi-arid conditions. From 1989 to 2003, research activities were supported by funding from European Union (EU), and GoK. The EU funding sustained implementation of NARP I and ARSP II programs. This support was resumed in 2007 under Kenya Arid and Semi-arid Lands (KASAL) research programme up to the end of 2010. Currently the EU continues to fund another phase of research program, Arid and Semi-Arid Lands Agricultural Productivity Project (ASAL-APRP) under Kenya Rural Development Programme which came to an end in April 2017. The donor funds have been used to enhance research capacity through physical infrastructural development, purchase of research materials, training scientists, and more importantly initiating and supporting up-scaling on-farm adoption research for increased agricultural productivity. In 2014 when KALRO was created through an act of parliament, Kiboko Centre was elevated to become the headquarter for Arid and Rangelands Research Institute (ARLRI). **Where we are:** The Centre is located at Kiboko Location in Makindu Sub-County of Makueni County, about 160 km SE of Nairobi, along Mombasa - Nairobi Highway with the offices being located 6 km south of the Kiboko market, on Mwailu Hill. It lies between latitude 2° 10' and 2° South and longitude 37° 40' and 37° 55' East. The ARLRI suitability for arid and range research is typical because it is located in ecological zone V which, generally, is not suitable for arable agriculture but ideal for extensive production of cattle, goats, sheep and even camels.
Research Mandate	The Institute has 5 Research objectives. These are: • To generate and promote technologies and innovations for demand driven arid and range lands value chains. • To develop and promote markets and marketing strategies for arid and range lands value chains

	• To facilitate and advocate policy options for enhancing demand-driven arid and range lands value chains • To strengthen the capacity for implementing arid and range lands value chains research. • To enhance availability of knowledge, information and technologies on arid and range lands value chains. In an effort to achieve above objects the Institute recognizes the importance of Private Public Partnership (PPP), collaboration with both relevant national and international agricultural research organizations and strengthening the farmer-extension-research linkages.
Functions	The overall function of Arid and Range Lands Research Institute (ARLRI) is two-fold: (1) Advise on and develop appropriate systems to promote balanced, diversified and sustained agricultural development and to optimize agricultural production through adaptive and investigative research; (2) Facilitate the use of improved production technology and to establish adequate feedback systems from agricultural producers in order to achieve and maintain national self-sufficiency and export capacities in products. Specifically the institute's main activities are: 1. Organizing, designing and carrying out on-station and on-farm research in the rangelands (arid and semi-arid drylands) as prioritized by the Institute. 2. Identification of production, policy, market, processing and utilization constraints in rangeland value chains and prepare short and long-term research programs within the framework of the national agricultural research system; 3. Identification and dissemination, in collaboration with other relevant agencies, appropriate systems of mechanization and technology options to improve agricultural production and provide answers to foreseeable problems facing rangeland production 4. Collaboration with the extension and education services and other organizations, agencies and institutions including schools, technical institutions and universities, public or private, to disseminate research results and technologies; 5. Establishment and maintenance of regular contact with regional and international agricultural research Centres to ensure the rapid introduction, evaluation and use of improved technology of potential benefit to the country; 6. Conduct, in association with the secretariat, annual reviews of research results and modify research programs as appropriate;

	7. Promotion of demand-driven participatory research, planning and priority setting
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Centres	Kiboko - involved mainly in range management research (email: kalro.kiboko@kalro.org) Turkana - involved in both range and crops research

The ASAL-APRP Project

The EU funded ASAL APRP project came to an end during the year under review. This was a 5-year project (2001-2017) which was aimed at building on the achievements of the KASAL project and also develop new technologies, information and knowledge suitable for the ASAL areas. The overall goal of the project was to improve food and nutritional security and the income of communities living in the ASALs of Kenya. Several KALRO Centres and project partners were supported by the project. In Kiboko, the following activities were implemented under the project:

1. Range Grass Seed Multiplication and Bulking in the ASALs
2. Collection, Conservation, Characterization and Evaluation of Indigenous Pastures for Increased Feed Availability and Improved Beef Production in Kenya's ASALs
3. National Performance Trials (NPT) for Enteropogon macrostachyus and Chloris roxburghiana. Distinctiveness, Uniformity and Stability (DUS) for *Cenchrus ciliaris* ecotypes
4. Morphological Characterization of Panicum Maximum and Cenchrus Ciliaris ecotypes
5. Genetic Characterization of C. Ciliaris, E. Macrostachyus and P. Maximum Range Grass Species
6. Effect of induced water stress on ecotypes of *Cenchrus ciliaris* and implication for drought tolerance
7. Greening Arid and Semi-Arid Lands and Improving Livestock Productivity
8. Characterizing On Farm Tree-Grass Combinations in Kibwezi and Kathonzweni
9. Participatory Training on Feeds and Feeding of Dairy Cattle for Improved Milk Productivity in Loitokitok Sub-County
10. Effects of Various Supplements on Performance of Beef Cattle and On Rumen Microbial Community
11. On-Farm Testing Of Chumvi Kuria and Chumvi Kuria+Se In Wajir And Garissa/Tana River Counties Of Kenya
12. Chumvi Kuria (Ck) And Chumvi Kuria+Selenium (Ck+Se) Financial And Sales Plan
13. Out-Scaling and Up-Scaling Of Pasture and Livestock Improvement Technologies in the ASALS

More information on the project is contained in: Improving Livestock Productivity and Nutritional Security in the ASALS of Kenya: A report on the ASAL-APRP Project activities at KALRO Kiboko 2012-2017.

HUMAN INTEREST STORIES

Out-scaling and up-scaling livestock technologies for improved livestock productivity in Loitokitok Sub-County

By Bernard K. Korir and Kidake Bosco K.

Kenya Agricultural and Livestock Research organization (KALRO) is involved in generation of livestock improvement technologies for increased productivity. Through the GoK and EU funded project, Arid and Semi-Arid Lands Agricultural Productivity Project (ASAL APRP ASAL-APRP), the Arid and Range Lands Research Institute was involved in outscaling of appropriate ASAL technologies targeting the dairy keeping small scale farmers and households in Loitokitok.

Previous reconnaissance visits found most chain actors in the Dairy Value chain lacked knowledge on proper milk handling and storage requirements. As a result there was a high prevalence of sub-clinical mastitis, a condition that poses a huge challenge to establishment of milk collection system in the area. Additionally, general husbandry practices such as use of proper zero grazing units, farm hygiene, feed scarcity and use of appropriate feed and feeding regimes was also identified as some of the challenges affecting optimal and quality milk production in the area. This informed KALRO's interventions of introducing and upscaling already existing technologies in order to reverse the trends of reduced livestock productivity. One approach involved the identification of champion farmers who could be co-opted in the project and their farms used as demonstration sites for ASAL technologies. Among the farmers were John Njenga Muigai, a mixed livestock and crop farmer from Entarara village. Mr. Muigai has been practicing dairy farming for a long time yet his production levels have been low. This was attributed to poor feeds and feeding practices. Like most other farmers in the ASALs, he used to feed crop residues to his livestock. The crop residues, mainly dry maize stovers were not stored well. When the EU funded ASAL APRP project identified groups to be trained on improved husbandry practices, his, Olepolos Help group, was one of the many beneficiaries. Together with other farmers of the group, they set aside one acre of land for demonstration of suitable range pasture technologies. With the assistance of KALRO and the County Government of Kajiado, the farmers were assisted to acquire pasture seeds, mainly *Eragrostis superba, Chloris roxburghiana, Enteropogon macrostachyus and Eragrostis superba.*

Participatory establishment of range pastures on John Njenga's farm (left) and the same farm regenerating after the first cutting of the range pastures (right)

Demonstration set-ups for pastures and other fodder varieties were also put at different sites within the sub county where farmers were trained on establishment, management and utilization of feeds. Over 600 farmers were reached with these technologies. In addition, they were assisted to acquire improved varieties of pasture, nappier grass, legumes such as vetch, lupins and fodder vines to establish on their farms for feeding livestock


A KALRO officer, Dr. David Miano training farmers on appropriate fodder varieties and utilization in Kimana, Loitokitok

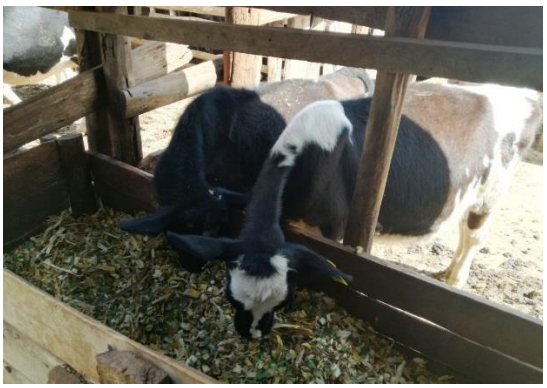
Loitokitok Sub-county is a major food producer due to favourable climate in most of the regions around Mt. Kilimanjaro and availability of water for irrigation. Previously, farmers were poorly utilizing crop residues including maize stover leading to wastage.


Poor feed conservation and preservation strategies which were in existence before the intervention of the project

It was found necessary to offer small scale training packages on feed conservation in form of tube silage. As a result, many farmers have got year round feed supply for livestock which has led to earlier weaning weights, more milk production and time saving by farmers for other farm activities.


Farmers being trained on appropriate feed conservation strategies by Dr. Miano of KALRO

Improved small scale hay structure at a farmer site

Poor feeding and unhygienic conditions (left) and improved feeding conditions (right) after the trainings in Loitokitok

Farmers were also taught the importance of good housing and feeding with practical demonstrations in the field. Previously, their milk was rejected due to poor quality by the Cooperative. Thanks to KALRO and the County Government, the scenario has been reversed, according to the manager of the milk cooperative.

Clean milk facilities and containers at a farmer's cattle boma in Loitokitok and training on milk hygiene

A field day was eventually held at John Njenga's farm which provided a suitable opportunity to display various livestock technologies by KALRO and partners to different participants and a wider audience. The theme of the field day, which was graced by the Deputy Governor, Kajiado County – Hon. Paul Ole Ntiati and the Deputy Director General KALRO, Dr. Joseph Mureithi and was ***'Enhancing technology in agriculture and industry for food security and national growth'***. A total of 431 people and over 200 students from local schools attended the field day. On display were various technologies aimed at improving the value chain in livestock management from feeds and feeding, milk production, processing and value addition.

(A) ***(B)***

*KALRO Research Officers (Everlyne Kirwa **(A)** and Bosco Kisambo **(B))** right explain to local farmers and students the importance of the selection of the right range grass species for the ASAL areas of Kenya*

Mr. Joseph Bii a KALRO Research Scientist explain on storage and management of dairy feeds to local farmers in Loitoitok sub-county

(A) ***(B)***

Mr. Amos Adongo (A) a KALRO nutrition expert and Sylvia Karebe (B) from Inua Maisha LTD demonstrate to farmers the aspects of milk hygiene handling

*Mr. Bernard Korir demonstrates the **performance of beef cattle** in the ASAL areas of Kenya. Ms Janet Kimutai takes the Chief Guest through the economics of livestock production in the ASALs*

Exhibition of dairy animal good housing, disease prevention and leaflets to participants. Farmers and Project Coordinator Dr. George Keya appreciated the dairy animal housing display.

KALRO staff performs a demonstration the dairy value chain School pupils from Olmaroroi Secondary School

Technology adoption

Daniel Ngaliku, a pastoralist from Munyura location, after several years of disappointment and feed scarcity, decided to venture into producing his own feed from his two-acre farm. Armed with the knowledge gained from the trainings and exposure by KALRO, the enthusiastic farmer was assisted to acquire planting material by KALRO and established on his farm. ‘*’I’m now able to feed my animals without having to travel for distances while looking for feed. My animals have also increased milk production after I fed them on a variety of feeds and not just the dry grasses I was used to*’’ Mr. Ngaliku told the gathering at the field day in Entarara.

Mr. Daniel Ngaliku, proudly showing his improved nappier grass multiplication site and rehabilitated farm to visiting Officers from the State Department of Livestock and KALRO

Overall, Farmers in the Sub-County are now able to utilize the information gained through their interaction with KALRO and partners through the trainings, field day, exposure tours to increase their returns from dairy cattle raring and improve their standards of living. As a result, the once dormant Loitokitok Dairy Farmers Milk cooperative Society is gradually roaring back to life. Farmers are now able to deliver clean milk production to the society hence increasing incomes.

Battling drought and poverty through pasture seed production and distribution for range rehabilitation and improvement

By Kidake Bosco K

With dwindling pasture resources in the ASALs of Kenya and increased awareness, the demand for quality pasture seeds has been rising hence the need to put in place mechanisms and options to satisfy the demand. Efforts by farmers to improve their pastures and venture into pasture seed production has faced various challenges including unavailability of quality seeds. Range pasture seeds unlike other high potential grasses are not available in the formal marketing channels in Kenya.

KALRO Kiboko, through the Community based range seed production system has managed to set up a multiplication program through which range pasture seeds are multiplied and distributed to farmers either directly or through different organizations. From 2009-2016, a total of 14.2 tonnes of assorted grass seeds have been harvested from the Centre pasture plots while close to 10.3 tonnes have been distributed to farmers in the country's ASALs.

Table 1 shows the amounts of seeds distributed from the year 2009 – 2016 to farmers through various organizations and sites in the country. These are mainly institutions and projects undertaking pasture improvement and rangeland rehabilitation. The main grasses include *Enteropogon macrostachyus* (bush rye), *Eragrostis superba* (Maasai love grass), *Chloris roxburghiana* (horsetail grass) and *Cenchrus ciliaris* (African foxtail grass) which are the species of choice for reseeding and pasture improvement in ASALs. Farmers are now able to harvest and sell seeds hence improving their incomes and livelihoods. A local CBO, Kavatini Livestock and Pasture Improvement Group, (KAPALIG) has been able to bulk and sell close to 2525 kg of assorted seeds since the year 2014. This translated to over Ksh. 1.7 million shillings. Many other farmers are engaged in the activity individually and have improved their lives.

Farmer field in Makueni County reseeded with pasture seeds from KALRO Kiboko

Harvesting of *Eragrostis superba* pasture seeds

Table 1: Top recipients of range pasture seeds from KALRO Kiboko

Recipient	2009	2010	2011	2012	2013	2014	2015	2016	Total
Makueni County	211	142	251	194	288	613	1,673	789	**4,160**
Ministry of Agric.					60		1,600		**1,660**
University of Nairobi				20		6	1,119	3	**1,148**
ILRI								910	**910**
Kajiado County	18	68		31		25	709	2	**853**
Others									**1,554**

Pasture seed from Kiboko being loaded to a van destined for Samburu for reseeding

RESEARCH AND OUTREACH ACTIVITIES

Participatory Training on Milk Hygiene, Feeds and Feeding of Dairy Cattle for Dairy Value Chain Players in Loitokitok Sub-County, Kajiado County

Kidake K. B, Adongo A. O, Kariuki J. N, Kubasu D and D. M Mwangi

1. Introduction

Kajiado County is one of the arid and semi-arid land (ASAL) counties in Kenya. The major economic activity carried out in the region is livestock production. According to report by department of Livestock Development (2014), Loitokitok Sub-County is home to 2798 dairy cattle giving annual milk supply of 3.4 million litres. Additionally a substantial number of zebu cattle provide 1.55 million litres of milk annual retailing at KES 60.00 per litre. This translates into KES 297M. Despite the opportunity presented with this volumes of milk, the area still faces many challenges in optimizing productivity of dairy sector.

Through the ASAL-APRP project, interventions geared towards improving livestock productivity with a focus of increased milk production were promoted in Loitokitok Sub-County.

Feed availability is an important aspect of milk production by dairy animals and in general animal nutrition.

Reconnaissance visits were used to help identify training needs on milk hygiene and husbandry related issues. During these visits, it was observed that most chain actors in the area lacked knowledge on prevalence of sub-clinical mastitis, a condition that poses a huge challenge to establishment of milk collection system in the area. Additionally, most milk producers in the area had challenges and limited knowledge in terms of milk handling, feeds and feeding and general animal husbandry which could influence optimal milk productivity, milk collection and marketing.

In view of the above, a team was constituted to plan for interventions aimed at improving the dairy value chain in the area. Capacity building aimed at improving quantity and quality of milk was prioritized as one of the major output of the project. Training on animal husbandry primarily on husbandry of a dairy cow, types of feeds, utilization and housing was carried out. It was anticipated that the capacity building on the different facets will impact on three key outputs-: increased milk quality, increased milk quantities sold to the trader and better production of quality milk would lead to increased income along the value chain and particularly farmers.

1.1. Objective

The main objective of the activity was to participatory train farmers in Loitokitok Sub-County on suitable ASAL technologies in livestock production for increased milk productivity. Specifically the activity aimed to:-

a) To participatory establish at least 10 pasture and demonstration sites in different sites in Loitokitok Sub-County
b) To train farmers, Extension and Inua Maisha Staff on various animal husbandry topics for increased productivity including disease management, calf rearing, housing and nutrition
c) To train farmers, Extension staff, Inua Maisha Staff on hygienic milk production and Handling and training farmers, Extension staff, Inua Maisha Staff on Feeds and feeding of dairy animals.

2.0. Methods and Approaches

2.1. Community Mobilization and Targeted Sites

The role of mobilizing farmers and other chain actors was delegated to the partner in the project, Inua Maisha Ltd and the Sub-County Livestock Extension staff. For effective and inclusive participation of major players in the training, the team looked at sites, cultural practices and the potential of the each site and willingness of farmers to supply milk. Agro ecological zonation of Loitokitok informed the selection of sites for training. There are four agro ecological zones in Loitokitok thus, high potential zone, Transition zone and semi-arid zone. Based on ecological zonation the sites selected included Olchoro (high potential), Enatrara (transition zone), Munyura (marginal zones) and Elarai (Rangelands- mainly practicing pastoralism)

2.2. Identification of participants

The number and type of people to be trained were categorised based on their role in the dairy value chain in the area and willingness to eventually sell milk to Inua Maisha LTD. Thus participants included-:a) champion farmers (Farmers with positive attitude and self-drive for the project that included both men and women and mostly those doing daily milk handling), b) Inua Maisha staff, c) extension staff, d) Transporters and e) Input suppliers. Trainings were organized at different sites based on the objective of the activity on the particular date.

2.3. Approaches

Various approaches were used to out-scale the suitable ASAL technologies which focused on feeds and feeding as well as animal husbandry in Loitokitok Sub-County. These included: -

Training of trainers and farmer training

Selected trainees were trained in a central place and then sent to the field to train at least 30 farmers from each site in their areas of jurisdiction.

Use of training manuals

The trainers adopted a manual developed by experts in the dairy sector (Lore *et al.*, 2006) for hygienic milk production to train participants on milk hygiene. Feeds and feeding was facilitated using a manual by Kariuki & Muia 2012 and several brochures on various KITs.

Participatory training on establishment of suitable fodders

Experimental work and field demonstration plots

Due to different ecological zonation in Loitokitok Sub-County ranging from Zone II to IV, it was imperative to test different suitable pasture and fodder varieties and species for recommendation to farmers in the respective sites. The team carried out field demonstrations at each time of visit in order for the farmers to have first-hand experience on appropriate technologies. Mobilization was done in advance by the responsible livestock extension staff and Inua Maisha Ltd

Participatory training of farmers at on the Demonstration sites in Kimana, Loitokitok

Discussion using question_answer techniques

This technique was used to enhance active participation and also to generate more information regarding the dairy sector in the different study sites. The trainers adopted a two way approach to question answer technique. Whereas farmers asked more question to deepen their understanding on the new concept given, trainers used question sessions to triangulate level of understanding on the trained package.

3.0. Results and Discussion

3.1. General Constraints identified in Loitokitok concerning dairy production

Below were some of the constraints identified during the reconnaissance visits, trainings and observations. The list however is not exhaustive.

- Poor housing structures and hygiene
- Lack of market for the milk produced
- Low milk yields (average of 2 Litres)
- Lack of organization among farmers in terms of milk marketing
- Diseases in dairy cattle
- Poor handling of milk – use of plastic containers
- Poor linkages with other chain actors
- Lack of records on milk production and marketing
- Lack of awareness of sources of dairy equipment
- Lack of planting material for livestock feeds among farmers and inadequate knowledge on suitable feed resources
- Poor feed processing, storage and handling
- Feed scarcity especially during the dry seasons
- Inadequate knowledge on suitable breeds of dairy cattle

3.2. Trainers and Farmer training

A total of 29 Trainers were trained in a training of Trainers (ToT) model and were used to train farmers during the implementation of the activities in the sub-county. They in turn trained 628 farmers (58%) against a targeted 1100 farmers for the project on the various technologies that had been passed unto them by the KALRO staff. In addition, KALRO officers also trained farmers during the different times they visited the sites, specifically during the experimental work that was a sub activity of the project.

Table 1 gives the number of participants in four training sites on milk hygiene and handling component. Generally farmers' turnout and their enthusiasm was evident. A total of 206 (Male = 52 and Female =154) representing 25.2 and 74.8% for male and female respectively. In addition, three Loitokitok Sub-County extension officers and those from Inua Maisha were trained. Although the team had targeted 300 for the training, the number was not achieved owing to a number of factors that affected farmer participation such as market days and socio cultural activities. It is also important to note that the composition of participants changed in some sites depending on the training components. For example, most men preferred the feeds and feeding training component compared to women in the Olchoro, Elarai and Munyura whereas the reverse was true for the milk hygiene component. This implies that targeting for capacity building may need to focus on the relevant active players on the various production and marketing activities on the farm.

Table 1: Participants by gender and site during the milk hygiene handling training

Site	Male	Female	Total
Entarara	16	45	61
Olchoro	9	34	43
Munyura	18	30	48
Elarai	9	45	54
Total	**52**	**154**	**206**


KALRO Research officers training farmers in milk handling (left) at Olchoro fodders in Loitokitok

Milk handling training aimed at improving knowledge and skills of participants on factors influencing milk hygiene at farm level from milking up to basic quality control tests. On the other hand animal husbandry and fodder trainings focused on recommended zero grazing units, management and appropriate feeds and feeding practices.


Example of poorly maintained unit in Entarara (left) and clean recommended unit (right)

3.3. Establishment of fodder demonstration sites

During the year**,** five demonstration sites (Kiwanja ndege, Ilasit, Mbironi, Imbirikani and Rombo) and four trials (Rombo, Munyura, Kimana and Kiwanja ndege) containing range grasses, legumes and other fodders were established in different sites. These were for use in participatory training in establishment, management, harvesting, storage/preservation and utilization. The mother-baby approach that was used was a suitable for the targeted kind of training. The approach played a crucial role in showcasing some of the varieties to farmers who had not seen them before. In addition, some sites were used for participatory evaluation by farmers.


Demonstration sites with different livestock feed resources in Loitokitok

Practical trainings using demonstrations leave a lasting impression of the lessons taught especially to farmers. Demonstration on milk hygiene practices and quality test platforms were also conducted during the milk handling trainings in every site.

4. Key Achievements during the year in the project

- Overall, about 1600 farmers were reached with ASAL technologies
- 12 demonstration plot sites were established in Loitokitok. These were used to train farmers in a participatory approach
- 30 trainees trained as trainers in livestock, fodder and milk hygiene aspects. These trainers have been able to reach about 680 farmers
- Trials on tolerant (dryland and cold tolerant) varieties were carried out in Loitokitok
- Milk marketing channel establishment was initiated in Loitokitok. The linkage with County Government and Dairy cooperatives was exploited to ensure that farmers had a place to sell their milk.
- Several farmers adopted the technologies and were practicing them on their farms.

5. Challenges faced

- Changing weather cycles – a big problem in establishment and growth of some of the crop varieties
- Delays in rains onset was an impediment to establishments
- Shortage of planting materials to meet the high demands after the demos and trainings
- Lack of seeds and the correct seeds to plant/planting material was lacking among farmers
- Farmer participation was hampered by market days and key events such as weddings, funerals and cropping season activities.

Genetic diversity analysis on ecotypes of *Enteropogon macrostachyus* (Bushrye grass) and *Panicum maximum* (Guineagrass)

By Kirwa EC and Mutegi SM,

Introduction

Due to the economic importance of range grasses, understanding the genetic diversity among their ecotypes would provide important information that could be used in their selection and variety development. For some species like *E. macrostachyus*, there are no previous genetic diversity studies on the species. Molecular markers are not influenced by variable environmental conditions unlike morphological characters that are influenced by environment interactions. Sequence Related Amplified Polymorphism (SRAP) is highly polymorphic and more informative than AFLP, RAPD and SSR markers. Some of its advantages include simplicity, reasonable throughput rate, disclosure of numerous co-dominant markers and allowing easy isolation of bands for sequencing (Li and Quiros 2001). It has been used successfully in characterization for genetic diversity of tuffgrass species that included kikuyugrass and Bermudagrass (Budak *et al*. 2004) and *Hemarthria compressa* grass in China (Huang *et al*. 2012). Start codon-targeted (SCoT) polymorphism is another simple, highly polymorphic marker that is based on a single primer amplification reaction. It has been used in several plant genetic diversity studies where it has given highly polymorphic information. The plants studied include Orchardgrass (Jiang *et al*. 2014), Whipgrass (Guo *et al*. 2014; Al- Doss *et al*. 2011). The current study evaluated the genetic diversity of 22 ecotypes of *E. macrostachyus* and 22 for *P. maximum* grass species.

Materials and methods

Grass ecotypes of *E. macrostachyus* and *P. maximum* that had been established at KALRO Kiboko were used. Collection of leaf samples was done in May 2015 and DNA extraction done following procedure by Doyle and Doyle (1987). Two markers were used, Sequence Related Amplified Polymorphism (SRAP) and Start codon-targeted (SCoT) polymorphism. Seven different SRAP primers that gave clear bands during selection were used for each species (Table 1). The protocol for SRAP analysis was based on Li and Quiros (2001) while the PCR profile was done following procedure used by Huang et al., (2012).

Table 1: *List of forward and reverse Sequence –related amplified polymorphism (SRAP) primer combinations used in genetic diversity analysis of ecotypes of E. macrostachyus and P. maximum*

Item No.	*E macrostachyus*	Item No.	*P. maximum*
SRAP 4	ME_1 and EM 10	SRAP 4	ME_1 and EM 10
SRAP 5	ME_1 and EM_5	SRAP 5	ME_1 and EM_5
SRAP 6	ME_1 and EM_12	SRAP 7	ME_1 and EM_15
SRAP 7	ME_1 and EM_15	SRAP 12	ME_2 and EM_10
SRAP 12	ME_2 and EM_10	SRAP 20	ME_5 and EM_10
SRAP 20	ME_5 and EM_10	SRAP 42	ME_12 and EM_7
SRAP 48	ME_12 and EM_17	SRAP 48	ME_12 and EM_17

Similarly, seven SCoT primers were selected from a pool of thirty primers and used to analyse genetic diversity of *E. macrostachyus* and *P. maximum* ecotypes

Only bands that could be unambiguously scored across all the sampled populations were used in this study. Amplified fragments from both SRAP and SCoT, were scored manually for band presence (1) or absence (0). Analysis of molecular variance (AMOVA) was done on the presence/absence data matrix which gave within-population and between-population variation. Other analysis included Principle coordinate analysis (PCoA) based on genetic distances to visualize the genetic relatedness between individuals in each population in a two dimensional figure and construction of dendrograms to display population relationships. Mantel test was also computed using GenAlex to show the correlation between the two markers as well as their combined/pooled data.

Results and discussions

Genetic diversity analysis of *E. macrostachyus* using SCoT and SRAP

There was no significant differentiation (P>0.01) among the four populations of *E. macrostachyus* using SRAP markers but significant differentiation (P<0.01) was observed for the same samples using SCoT markers (Table 3). The large within population variation, 96 % with SRAP and 84 % with SCoT, could be as a result of individuals from different micro environments within counties.

Table 1: *Summary of analysis of molecular variance (AMOVA) results for 4 E. macrostachyus populations generated by SRAP and SCoT*

Source of variation	df	SS	MSD	% variation	F_{ST}	P-value
SRAP						
Among populations	3	57.7	19.9	4	0.044	>0.01
Within populations	17	265.4	15.6	96		
SCoT						
Among populations	3	45.7	15.2	16	0.162	<0.01
Within populations	17	130.8	7.7	84		

Degrees of freedom (df), sum of squares (SS), mean of square deviation (MSD), % variation, Genetic differentiation among populations (F_{ST}) and P-values.

Using SCoT marker, Nei's unbiased measures of genetic distance indicated that the shortest genetic distance was between Taita Taveta and Makueni 0.068 and the largest distance between Taita Taveta and Narok 0.193. This results are more clearly shown by Principle coordinate analysis that reveal the genetic relatedness among populations. Most of Taita Taveta individuals clustered on one side with (Figure 1).

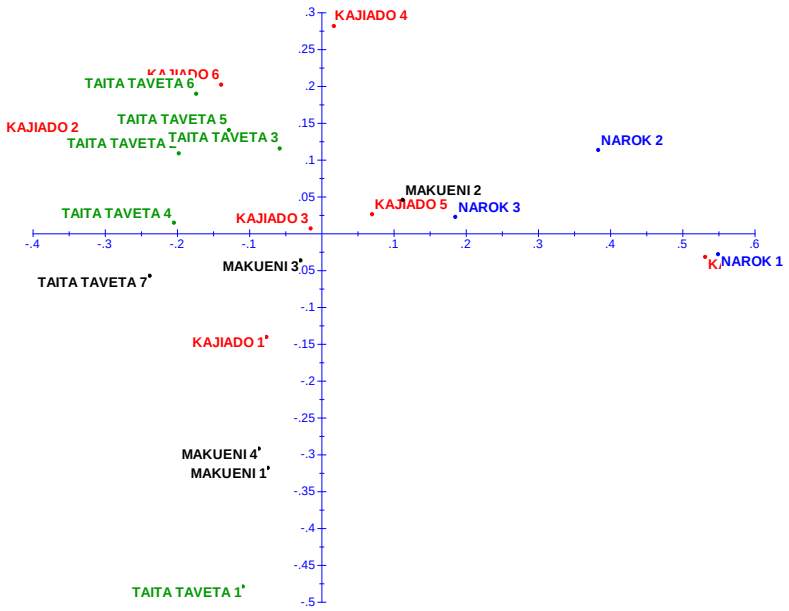


Figure 1: *Principle coordinate analysis of the E. macrostachyus samples using (a) SRAP and (b) SCoT markers, respectively.*

Dendrograms produced with DARwin were similar for both markers with four clusters for SRAP, SCoT and pooled data for both markers with minimal outliers in each cluster indicating that both markers can be used successfully in genetic diversity of *E. macrostachyus*. However, SCOT markers were more polymorphic than SRAP with the species. Thus SCoT can be further used to study genetic diversity of *E. macrostachyus*.

Kajiado population had the highest diversity values for both markers systems among the *E. macrostachyus* populations. This could be due the wide geographical distribution of the collection sites in Kajiado County. Variation in diversity values have been attributed to dispersal, mode of reproduction, habitat, geographical distribution and also population history (Xia *et al*. 2002). Physical distribution of *E. macrostachyus* could have contributed to its increased genetic variation in certain regions. The sampled regions: Kajiado, Narok, Makueni and Taita Taveta, are expansive spanning thousands of Km apart. In addition, they encounter different climatic conditions in terms of altitude and temperature. A broadly distributed species rarely has the same genetic makeup over its entire range. This could have contributed to Kajiado having a higher genetic diversity.

Genetic diversity analysis of *Panicum maximum* using SCoT and SRAP

There were only three populations for *P. maximum*; Kajiado, Narok and Taita Taveta. Both SRAP and SCoT gave significant differentiation ($P<0.01$) among the three populations of *P. maximum* using SRAP and SCoT markers Table 2. Large within population variation, 93 % with SRAP and 96 % with SCoT, could be as a result of individuals in different micro environments within counties. Morphological characterization of ecotypes indicated differences among them in traits measured such as plant height, leaf length and width, stem thickness, leaf and stem hairiness, among others. Some ecotypes were robust and others small types.

Table 2: *Summary of analysis of molecular variance (AMOVA) results for three P. maximum populations generated by SRAP and SCoT*

Source of variation	df	SS	MSD	% variation	F_{ST}	P-value
SRAP						
Among populations	2	28.3	14.1	7	0.074	<0.01
Within populations	20	176.6	8.8	93		
SCoT						
Among populations	2	32.3	16.2	4	0.044	>0.01
Within populations	20	239.7	12	96		

Degrees of freedom (df), sum of squares (SS), mean of square deviation (MSD), % variation, Genetic differentiation among populations (F_{ST}) and P-values.

SRAP dendrogram indicated that most of the Taita Taveta collections were closely related and similarly for three Narok samples (Figure 2).

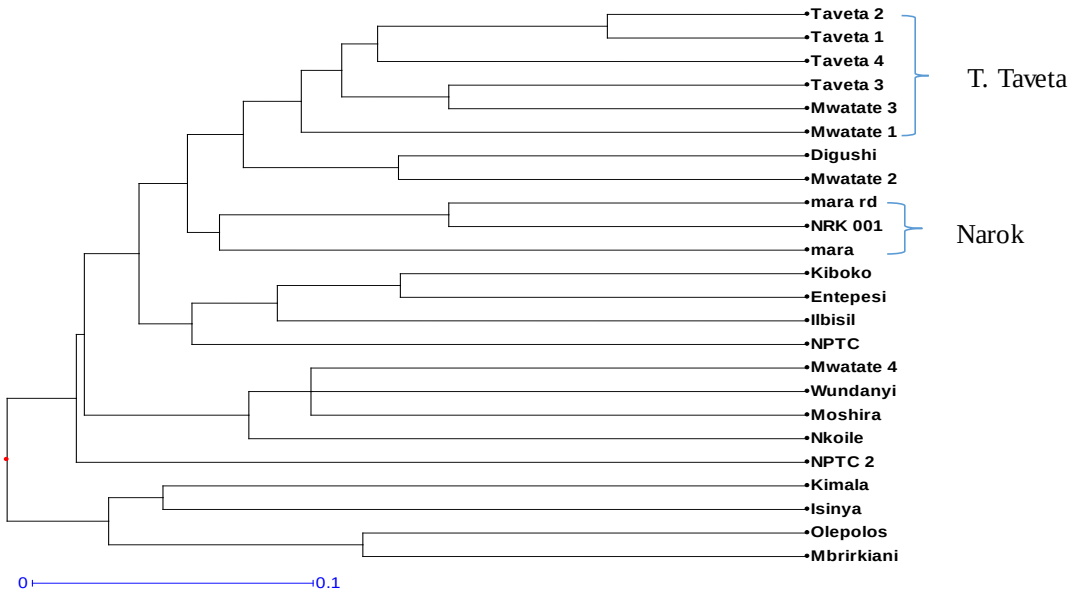


Figure 2: *unweighted pair-group mean algorithm (UPGMA) dendrogram for P. maximum generated using SRAP markers.*

Dendrogram developed using SCoT markers also indicated the three Narok collections were closely related as well as two collections from Taveta, Taveta 1 and Taveta 2 (Figure 3).

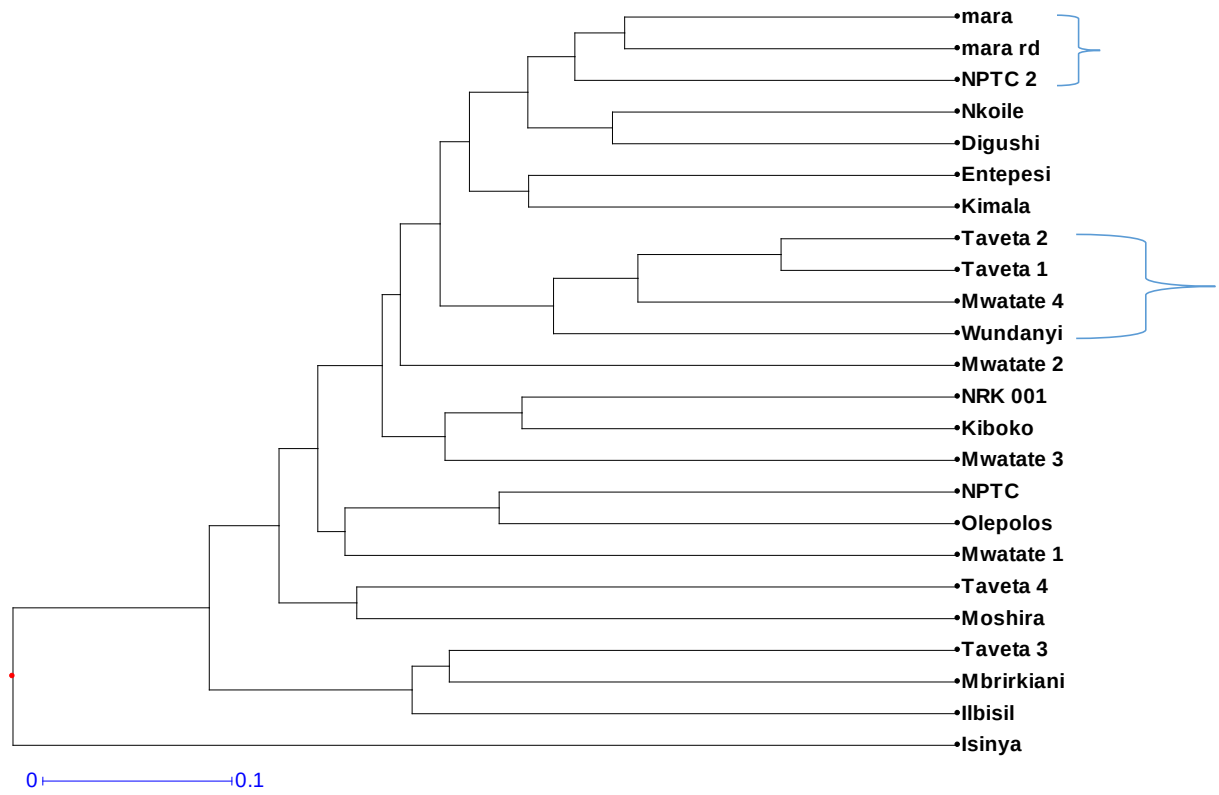


Figure 1: *unweighted pair-group mean algorithm (UPGMA) Dendogram for P. maximum generated using SCoT markers.*

The Taveta 1 and Taveta 2 ecotypes were closely related in cluster analysis using selected morphological traits. Further analysis of collection data sheets is necessary since Taveta 1 and Taveta 2 samples may be the same material. Other similarities with morphological data were observed with SCoT markers. Kiboko clustered together with Mwatate 3 while Wunda nyi clustered together with Taveta 1 and 2. With both markers Isinya seemed to be distantly related with other collections. It was not clustered with SCoT but with SRAP it was clustered with three others but distantly. Such an accession could be used in hybridization studies so as to benefit from its possibly uniqueness.

Conclusion

Diverse populations of *E. macrostachyus* like Kajiado, can be incorporated in possible inter population hybridization that can improve the quality and quantity of forages production through new *E. macrostachyus* varieties. Given the variation observed among *E. macrostachyus* collections, there is also need for renewed effort to populate its germplasm with materials from other different agro ecological zones. The significant diversity results observed in *P. maximum* with SCOT indicated that the marker could be used to successfully analyze genetic diversity with the species.

Acknowledgement

The authors acknowledge the funding support f ASAL APRP for supporting ASAL wide collections of grass germplasm and the lab activities. Thanks also to the Director General KALRO and KALRO Kiboko and Biotech staff for their logistical assistance.

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Exploration and collection of germplasm of ecotypes of selected range grass species

By Kirwa EC, Nyamongo DO, Mnene WN, Nyaboke B.

Introduction

The declining diversity and quality of pasture resources due to genetic erosion brought about mainly by desertification, population pressure on land, changes in land use, over-exploitation, drought and floods is a major challenge to continued development of the beef industry in the Asals. Over-reliance on just a few pasture species for rangeland beef production is a major risk particularly in the face of climate change. Fodder and pasture diversification is critical to avert the risk. Thus, this project endeavoured to collect and conserve promising indigenous pasture species, characterize their diversity and evaluate their potential as alternative pasture and fodder resources in support of rangeland beef production. The target species include: *Panicum maximum, Cenchrus ciliaris, Enteropogon macrostachyus, Eragrostis superba, Digitaria macroblephara, Chloris roxburghiana* and *Brachiaria spp.*

Methodology

Collections of grass germplasm in form of seeds or splits were made in September and December, 2016 in the North Western region represented by Baringo and West Pokot Counties and Northern region by Turkana County. The collected seeds were packaged in envelops and submitted to the Genetic Resources Institute (GERRI) at Muguga for processing and storage. The plantlets were uprooted and put in plastic bags then kept moist throughout the field excursions. The plantlets were then taken to KALRO Kiboko for management and characterization. For every collection, a herbarium sample was collected for identification and sample registry into their database and storage for future references at the National Museums of Kenya (NMK).

Results

A total of 26 collections were made from Baringo South, Baringo North and Tiaty Sub-Counties. A high diversity of grass species was observed at the Iljamus community dry season grazing area in Arabal, Mukutani ward where a total of 10 ecotypes comprising five of the target species.

Collection scenes in Mukutani site, Baringo South Sub-County

Sample panicles of Cenchrus cilliaris, Chloris roxburgiana and Eragrostis superba

Parmalok Island in Lake Baringo had almost 100% ground cover of *C. ciliaris* and is believed to be the source of the Baringo variety of the species. The island effect on the species could make the ecotypes have unique traits.

Parmalok Island

Kapedo waterfalls

A rare occurrence of *C. ciliaris* that is potentially salt tolerant was found around Kapedo water falls in Tiaty sub-county. Non-target grass species, *Leptocloa obtusiflora* that is abundantly available on degraded sites in Tiaty was recommended by locals as a priority species.

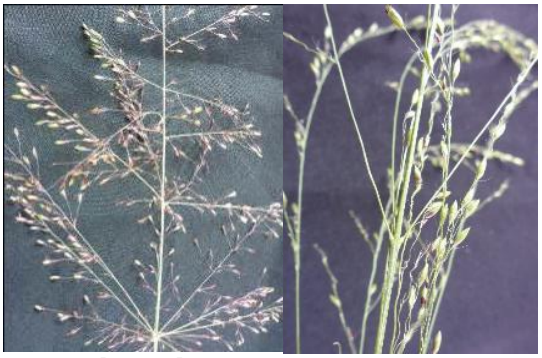
Leptocloa obtusiflora on rocky habitat in Chemolingot; Glumes of Leptocloa obtusiflora

A total of 24 collections were made in West Pokot County where target areas were Pokot west, Pokot North and Pokot South Sub Counties. *Brachiaria brizantha, Brachiaria lachnantha* and *Panicum. maximum* were collected mainly in the higher altitudes in Pokot West Sub-County. A non-target species, *Crotalaria jacksonii* which was growing together with the grasses and could be a good legume fodder plant was collected in Riwo ward.



(a)Brachiaria brizantha, (b)Brachiaria lachnantha and (c)Crotalaria jacksonii Samples from Pokot West


Germplasm collection in West Pokot



Purple and green P. maximum at Chepararia, Pokot South

Two different ecotypes of *P. maximum* were collected at the same site in a grazing land at Chepareria, Pokot South. One had green coloured head and the other purplish.

A total of 48 collections were made in North western region (Table 1)

Table 1: Summary of range grass accessions collections from the ASALS

Species/ Region	*E. macrostachyus*	*Bracharia species*	*C. roxburghiana*	*E. superba*	*C. ciliaris*	*P. maximum*	*Others*	*Total*
N. Western (Baring & West Pokot)	6	3	1	9	9	14	6	
Northern (Turkana)	3	-	3	3	12	2	1	
Total	**9**	**3**	**4**	**12**	**21**	**16**	**7**	**72**

A total of 24 ecotypes were collected from Turkana County comprising of five main target grass species (Table 1). The highest collections were made on *C. Ciliaris* grass species with twelve ecotypes.

Discussions

Findings of these collecting expeditions in the rangelands clearly confirm that pasture diversity, like any other form of biodiversity is on the decline. Land use changes is a key driver of habitat degradation and subsequent genetic erosion. The genetic erosion negatively affect pasture improvement initiatives due to narrowed genetic base that is critical in any breeding program. The threats to vegetation included soil erosion, overgrazing and human settlement. Aslo, land use change such as excavations for road construction.

Effects of soil erosion in Pokot West

Collection of Panicum species in mango plantation in Barwessa, Baringo County confirmed the fact that the species is a shade tolerant grass.

Conclusions

A decline in pasture diversity was observed during the expeditions due to the on-going habitat destruction. Thus, there is need to develop and promote initiatives aimed at securing pasture diversity including the non-target species in *ex situ* conservation facilities. The collection of potentially salt tolerant *C. ciliaris* ecotype in Kapedo was exciting and the ecotype should be further analyzed for salt tolerance.

Outreach Activities during the 2016/2017 Year

By Bernard K. Korir

The Institute participated in 5 different outreach forums which were meant to expose the stakeholders in the livestock industry to novel technologies which will help them improve the productivity of cattle, goats and sheep in the arid and rangelands. Two of the forums were organized by USTADI Foundation in collaboration with the USAID and Land O Lakes. These two forums were held in Makindu on the 21st July 2016 and Ekalakala on the 10th of August 2016 in Makueni and Machakos counties, respectively. Two were organized by the Agricultural Society of Kenya (ASK) in Mombasa and Kabarnet. The Mombasa show was held between 29th August and 4th September 2016 while that of Kabarnet was from 13th to 15th October 2016. The most recent Field Day was organized by the Centre in collaboration with other stakeholders and was held in Oloitokitok Subcounty of Kajiado on the 16th of February 2017. The main message was on reseeding of the rangelands with the correct species and the appropriate time and keeping of the right animals as well as value addition. Posters and live exhibits of the recommended range grasses were used to show case the recommendations by the Centre.

In the Kabarnet show, approximately over 1250 persons- mainly farmers had an opportunity of viewing and interacting with staff from different KALRO Centres and other organizations. Majority of the farmers were representatives of CBOs. The KALRO, ARLRI- Kiboko Centre stand attracted many people particularly because of the live pasture plants and grass seeds. Farmers wanted to buy the grass seeds but it was not possible since the Centre had ran out of seed stock. However, contacts were given to those who were interested in buying the seeds so that they can contact the Centre for any further possible assistance in obtaining the seeds. The DG KALRO visited the KALRO Kiboko stand and requested to be taken through the exhibits showcased by the team. In his remarks the role of KALRO and ALRI Kiboko was elucidated and its emphasis of research in pasture and livestock spelt out. He however emphasized on the need to bulk more seeds and be promoted to the wider ASAL parts of the country. The following is a summary of clients reached through these outreach activities;

Venue	Date	Number of visitors
Makindu	21/7/2016	600
Ekalakala (Machakos County)	10/8/206	807
Mombasa Show	29th Aug to 4th September 2016	536
Kabarnet Show	13th to 15th October 2016	1250
Oloitokitok Field Day (Kajiado County)	16th February 2017	451

A plot of *Eragrostis superba* at the Mombasa show

Seed on display at the Ekalakala livestock show in Masinga Sub county Machakos

Pupils also visited the KALRO stand at the Ekalakala livestock show in Masinga Sub county Machakos

Visitors taking notes at the KALRO stand in Makindu livestock show

Visiting Students/Farmers

Institution	Type	Participants
Mavoloni zone Yatta sub-county Head Teachers	Head Teachers	45
Kathikwani Priary School	Primary	53
Canaan Secondary School	Secondary	16
Joanna Chase Secondary School	Secondary	15
Voi Secondary School	Secondary	48
Kwakavisi Mixed Secondary School	Secondary	40
Mikuyuni Secondary School	Secondary	45
University of Kabianga	University	102
Kenyatta University	University	91
Taita Taveta Unviersity	University	32
Meru University	University	18
University of Eldoret	University	43
	Total	**548**

PUBLISHED PAPERS

Livestock Research for Rural Development Journal Papers

http://www.lrrd.org/lrrd28/8/cont2808.htm

Promotion of range pasture and fodder production among the pastoral and agro-pastoral communities in Kenyan rangelands: Experiences and lessons learnt

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Abstract

The rearing of livestock is an important activity in the Arid and Semi-Arid Lands of Kenya. Different activities have been implemented by different organizations with the aim of improving the productivity of the livestock sector. Key among them are geared towards the improvement of the feed resource base. The involvement of farmers and other actors in these initiatives go a long way in ensuring that successes are realized. However, challenges abound as these initiatives take centre stage during implementation.

We hereby review some of the experiences and lessons learnt during the interaction with farmers and livestock keepers as well as key informants in the Arid and semi-arid lands (ASALs) of Kenya while promoting pasture technologies in the recent past.

Keywords: *livestock production, pasture improvement, reseeding*

http://www.lrrd.org/lrrd28/12/cont2812.htm

Cost of production, marketing and revenue generation from somali camel breed in Isiolo and Marsabit counties of northern Kenya

S. G. Kuria, O. K. Koech, A. O. Adongo, S. Murithi, J. T. Njoka and P. Kamande

Abstract

This study was carried out in Isiolo and Marsabit Counties of northern Kenya to understand the marketing and profitability potential of Somali camel reared for milk and beef. The study involved a survey where 91 and 120 randomly selected respondents were individually interviewed in Isiolo and Marsabit, respectively using a semi-structured questionnaire. The data was analyzed using the IBM SPSS where independent samples t-test was carried out on quantitative data while, descriptive statistics were carried for the qualitative data and test for significance done using chi-square.

Market price for camels ranged from KES. 12,500 for male calves under one year to KES. 97,143 for mature females and were within the range reported by other researchers. The prices were higher in Isiolo than Marsabit for mature males which sold for KES. 55,971±3,637 and KES. 39,682±3,333 (p=0.038) respectively, but not in other age categories. Majority of the respondents (90.6%, n=77) in Isiolo estimated market value of camels before taking to the market compared to 67.7% (n=65) in Marsabit, suggesting Isiolo pastoralists were keen to know the market value before taking camels to the market. The commonly used method for estimating market value of camels was ocular assessment of the body size in combination with market information. Isiolo pastoralists spent more money on inputs such as antibiotics, acaricides and, herding labor and also sold more milk than their Marsabit counterparts (p=0.049).

In terms of revenue generation, pastoralists were making KES. 10,292 and 4,888 every month in Isiolo and Marsabit, respectively from sale of live camels and the milk. The fast expanding commercial rearing of Somali camels in peri-urban Isiolo and Marsabit was profitable to pastoralists.

There however appeared to be a variance between actual market value of camels and the price offered to farmers in the market suggesting some degree of exploitation by middlemen although no data was collected from the middlemen to validate this opinion. Considering the KES. 10,000 pastoralists were getting in Isiolo was based on the traditional management of the camel, it means the potential profitability of commercial rearing of the camel is much higher and could be exploited through training on improved camel management technologies.

Key words: camel milk, camel meat, profitability, capacity building, improved management technologies

http://www.lrrd.org/lrrd28/9/cont2809.htm

Acquisition and management of Somali camel breed for pastoral resilience within peri-urban Isiolo and Marsabit counties of Northern Kenya

S G Kuria, A O Adongo[1], S Murithi[2], O K Koech[2], J T Njoka[2] and P Kamande[2]

Abstract

A baseline survey was conducted in Isiolo and Marsabit Counties of northern Kenya to document the acquisition and current management practices of Somali camel keepers. Data collection was done using participatory methodologies i.e. semi-structured interviews and focus group discussions. Data was analysed using descriptive statistics and t-tests respectively.

The results indicated slight differences with Somali camel keepers in Isiolo obtaining breeding stock through market purchase and inheritance, whilst those in Marsabit obtained through market purchase and re-stocking programs. Majority of camel keepers in both Isiolo and Marsabit grazed their camels in shrub lands (65%, n=62; 41%, n=47 respectively) and on plain terrain (73%, n=71; 79%, n=86 respectively) suggesting good level of understanding on the type of vegetation and terrain suitable for Somali camels. Isiolo pastoralists were allowing an extra grazing hour (11.7 hours against 10.7), were watering the Somali camels more frequently especially during dry season (every 5th day against 7th) and were also allowing the calves to suckle for a longer period before

beginning to drink water than was the case in Marsabit (5.1 months against 3.8). These management practices are important for commercial camel rearing. In Isiolo, 90% (n=80; N=91) of respondents were feeding their camels with mineral supplement compared to 68% (n=73; N=120) in Marsabit (χ^2=14, p<0.001). In Marsabit, 41% (n=44) of respondents had recorded cases of heat repeat compared with 61% (n=54) in Isiolo. About 85% (n=77) of respondents in Isiolo had an average of 2 own breeding bulls compared with 73% (n=78) with an average of 1 in Marsabit. About 87% (n=72) of respondents in Isiolo understood what inbreeding is while 13% (n=11) did not (χ^2 = 201, p<0.001). The situation in Marsabit was such that 90% (n=99) of respondents understood inbreeding while 10% (n=11) did not (χ^2 = 70, p< 0.001). In Isiolo, pastoralists controlled inbreeding in camel herds by exchanging bulls with neighbors (51%, n=76); keeping more than one bull (25%, n=38) and ensuring bull did not mate related females (24%, n=36). Marsabit pastoralists on the other hand controlled inbreeding by exchanging bull with the neighbors (58%, n=52); ensuring bull did not mate related females (27%, n=24) and keeping more than one bull (15%, n=13). Isiolo pastoralists were retiring breeding bulls at 14±6.3 (n=76) years compared with 12.3±6.3 (n=101) in Marsabit. On the other hand, the Isiolo pastoralists were retiring females after 12±7 (n=67) calvings compared to 9±4 (n=62) in Marsabit. Close to 61% (n=52) of Isiolo respondents allowed calves to suckle all the colostrum while in Marsabit, 50% (n=45) did. When expressed as a percentage of the average number of camels per household (Isiolo =35; Marsabit = 6), the mortality in Isiolo was 3% against 17% in Marsabit. In conclusion, Isiolo pastoralists were doing better with respect to most of the management practices compared to their Marsabit counterparts. The study recommended capacity building in most of management aspects especially in Marsabit where commercial rearing of Somali camels is in the formative stage in order to improve performance and by so doing strengthen resilience of farmers to climate variability.

Key words: *camel performance, capacity building, commercial camel rearing, husbandry practices*

Tropical and Subtropical Agro-ecosystems Journal

http://www.revista.ccba.uady.mx/ojs/index.php/TSA/issue/view/60

Leaf Area Dynamics and Aboveground Biomass of Specific Vegetation Types of a Semi-Arid Grassland in Southern Ethiopia

Bosco Kidake Kisambo, Jan Pfister, Angela Schaffert, Folkard Ash

Abstract

Leaf Area Index (LAI) dynamics and aboveground biomass of a semi-arid grassland region in Southern Ethiopia were determined over a long rain season. The vegetation was categorized into four distinct vegetation types namely Grassland (G), Tree-Grassland (TG), Bushed-Grassland (BG) and Bush-Tree grassland (BT). LAI was measured using a Plant Canopy Analyzer (LAI2000). Biomass dynamics of litter and herbaceous components were determined through clipping while the above ground biomass of trees and shrubs were estimated using species-specific

allometric equations from literature. LAI showed a seasonal increase over the season with the maximum recorded in the BG vegetation (2.52). Total aboveground biomass for the different vegetation types ranged from 0.61 ton C/ha in areas where trees were non-existent to 8.80 ± 3.81ton C/ha in the Tree-Grassland vegetation in the study site. A correlation of LAI and AGB yielded a positive relationship with an R2 value of 0.55. The results demonstrate the importance of tropical semi-arid grasslands as carbon sinks hence their potential in mitigation of climate change.

Keywords: Biomass; carbon; Leaf Area Index; sequestration; grassland

Animal Production Society of Kenya Symposium 2017 Papers

Assessment of Growth Rate, Milk yield and Nutrition of Sahiwal and their Crosses with Small East African Zebu Cattle in Magadi, Kajiado County, Kenya

Bii J. C[1], Ilatsia E.D[2], Korir B. K[1], Katiku P.K[1], Mnene W. N[1], Kibet P.F.K[3], Keya G.A[4]*

Abstract

This study was carried out to determine the suitability of Sahiwal and their crosses with Small East African Zebu (SEAZ) in Magadi since this area is the driest in Kajiado County. Specifically the study aimed at determining farmers' perception on the suitability of Sahiwal and their crosses with SEAZ, determining the performance of Sahiwal and their crosses with SEAZ and come up with recommendation domains on use of Sahiwal in upgrading SEAZ in Kajiado and future research areas. The project was designed to purposely target farmers owning SEAZ, Sahiwal and crosses of Sahiwal and SEAZ cattle. A questionnaire was used to collect data and information which included the following parameters; Lactation length, Daily milk yield, Age at weaning, Market age, feed supplementation strategies, ranking of breed preference and Liveweight. The data collected was analyzed to compare means of the production parameters of the different breeds. The results showed that Sahiwal was ranked number one breed of preference because of high milk yield and high growth rate. The distance to agro-vet shops where mineral supplements could be obtained was reported to be 26km which was too long for most of the pastoralists.

Key words: Sahiwal, Small East African Zebu, Arid areas, Growth rate, Milk yield, Nutrition.

Upgrading the mutton value chain: A pilot community initiative in the ASALs of Narok, Kenya

Katiku PN[1], Keya GA[2], Nginyi J,[3] Manyeki JK[1],*

Abstract

A pilot research to business (R2B) model was developed and tested in Narok County with the objective of upgrading the mutton sheep value chain in the region. The model involved on-farm communal feedlot finishing of Dorper weaner lambs donated by and belonging to a local community based organization (CBO). One hundred and thirty two, four months old weaner lambs

were fattened for 3 months and collectively marketed under a public auction. The lambs attained an average market weight of 30 kilograms. Farmers were trained on strategic deworming as means to control helminths and improve the sheep productivity. Profitability analysis showed positive Net Present Value (NPV), Gross Margins (GM) and a Cost Benefit Ration (CBR). This means that the costs invested in the sheep lamb fattening scheme are recovered and high benefits realized. The project working with the CBO, managed to pioneer the sale of finished sheep lambs on live weight basis and at higher prices through public auction forum which was a new experience in the area. The fattening experiment observed that it was possible to finish and market sheep weaner lambs for a period of 3 months thus reducing the market age from the normal 2-3 years to about 8 months.

Key words: *Sheep- Finishing Narok Kenya.*

Does Mineral Supplementation Affect Quality of Camel (*Camelus dromedarius*) Milk? The Case of North Eastern Region of Kenya

S G Kuria[1], J Lesuper[2]

Abstract

A study was carried out in Bangali - Tana River County and Bute - Wajir County Kenya, to assess effect of mineral supplementation on the level of iron, zinc, selenium and vitamin A in camel milk. Design of the experiment was Balanced Randomized Complete Block (BRCBD) with factorial arrangement of the treatments. The two sites represented blocks. Treatments were at three levels i.e. {(Chumvi Kuria – CK, a mineral formulation for camels containing calcium, phosphorus, potassium, magnesium, iron, copper, zinc, cobalt), (Chumvi Kuria+selenium - CK+Se, a variant of CK containing selenium) and, the control}. Each camel was individually fed 200g/day of either CK or CK+Se every morning over a period of 90 days with a 7-days acclimatization period at the beginning. Milk samples for mineral analysis were taken at beginning of the experiment and thereafter once at end of every month and delivered to laboratory where iron, zinc and selenium were analyzed using Atomic Absorption Spectrophotometer (AAS) while vitamin A was analyzed using High Performance Liquid Chromatography (HPLC). Two way analysis of variance was used to analyze effect of treatments on iron, zinc, selenium and vitamin A while mean separation was done using least significant difference (LSD). The treatments did not significantly influence the level of iron in the milk from one month to the other although the CK+Se exhibited higher influence than CK. There was a general downward trend for zinc thought to be a result of negative interaction with selenium observed to increase over time with supplementation. The mean monthly difference for zinc was not significant at 0.05 level. Selenium concentration in the milk was positively influenced by supplementation although the treatment differences were not significant at 0.05 level. A downward trend for vitamin A was observed. However, the mean monthly difference was not significant at the .05 level. The study concluded that supplementation with both CK and CK+Se positively or negatively influenced concentration of the mineral elements and also vitamin A with the overall concentration remaining within the acceptable level for quality camel milk.

Key words: Mineral analysis, Iron, Zinc, Selenium, Vitamin A, Human health

Effect of induced water stress on ecotypes of *Cenchrus ciliaris* grass species and implication for drought tolerance

[1]Kirwa E.C, [2]Ikawa R.A., [3]Mutegi S.M and [2]Mnene W.N

Abstract

A study was done to evaluate the effect of induced water stress to ecotypes of *Cenchrus ciliaris* grass species. A total of seven ecotypes collected from collected selected areas in Arid and Semi-Arid lands (ASALs) of Kenya were planted in a green house. Effect of water stress was varied among the ecotypes. Extreme stress was observed with KBK2 ecotype where plant height change, observed plant appearance score and relative leaf water content was significantly affected by water withdrawal. Leaf proline content was highest in water stressed than well-watered plants. Leaf proline levels were significantly affected by water stress in KBK2 and KBK1 ecotypes. In overall, the results indicated that KBK2 ecotype is significantly affected by water stress implying low drought tolerance than the rest.

Arid and Semi-Arid Lands Agricultural Productivity Research Program End of Program Conference Papers

Feedlot finishing of sheep lambs for market: experiences of Nturumenti farmers, Narok County, Kenya.

Katiku PN, Keya GA , Nginyi JM, Manyeki JK, Mahagayu CM, Kimutai JK , Ogillo BP , Kimitei RK,Mnene WN, Kibet PF*

Abstract

A study was conducted in pastoral smallholder production site of Nturumeti, Narok County, Kenya to determine the success of onfarm feedlotting of sheep lambs for market. In the reseacher led farmer managed trial, 132 castrated male sheep lambs; aged 4 months and of mainly Red Maasai (RM) crossed with Dorper; were finished on grass and supplements – energy, protein and mineral- for a period of 99 days and offered for sale in a public auction at the end date. The mean liveweight at start of trial was 24.82 (s.e 0.52) kg and increased to 30.01(s.e 0.54) kg on the end date. At the start of experiment, 17.12.2015, there were 132 lambs, 6 lambs died in the course of the trial from bloat, sheep pox, blue tongue and complications arising from feeding. Therefore, 126 lambs finished the trial on 10/4/2016 and auctioned on 11/4/20166 during which an initial flock of 60 fat lambs weighing 30 (kg) and above sold out and on live weight basis, KES 130/kg, as the project intended. The remainder were disposed off within a week. The participating farmers observed that the new method of sale, live weight basis, was better than visual assessment system. The finished lambs returned profits of upwards of KES 2300 apiece and took 3 months to finish as opposed to the farmer practice of fattening for a period of more than a year. Therefore, the project working with the Community Based Organization (CBO) managed to pioneer the sale of finished sheep lambs on live weight basis and through public auction forum which was a new experience in the area. The current on-farm fattening experiment observed that it was possible to finish and market

sheep within a period of 3 months and the prices realized from sold sheep lambs were far much better than the prices obtained when similar lambs are sold on visual appraisal at farm gate.
Key words: *Auction, feedlot, Lambs, Nturumenti, Narok*

Pastoral land use and management strategies under the changing climate: The case of pastoral farmers of Narok County, Kenya

Katiku PN, Keya GA , Nginyi JM, Manyeki JK, Mahagayu CM, Kimutai JK , Ogillo BP , Kimitei RK,Mnene WN, Kibet PF*

Abstract
A study was conducted in pastoral smallholder production sites of Ololulunga and Nturumeti, Narok County, Kenya to determine land use changes, management and production strategies under the changing climate. Random sample of 32 households, five key informant interviews and four focused group discussions were conducted in November, 2014. The results indicated that livestock production and arable farming are competing favourably for the inelastic land resource owned and utilized by the households. On average, 50% of the households apportioned 50% of their farm, mean size of 7.5 hectares, for crop farming-mainly cereals (wheat and or maize) and the remainder for livestock activities. The usual pastoral herd, where cattle were predominant, is also changing with sheep becoming dominant. Furthermore, the traditional Red Maasai sheep is rapidly being replaced with Dorper which is a higher producer of milk and carcass. To support the large livestock numbers, deliberate pasture production and conservation practices; crop residue bulking and reseeding, are inbuilt in livestock rearing. The changing landuse and management strategy is posing serious land degradation threats; overgrazing, soil erosion and deforestation. Indeed, the infusion of modern land management innovations, technology and conservation strategies are integral in ensuring continued productivty of the land resource. – not conclusive and partly reflects the research findings
Key words: *ASAL, land, livestock, smallholder, Narok*

Performance of Rhodes Grass (*Chloris Gayana*) and Two Range Grass Ecotypes under Rain-Fed Rangeland Conditions in South-Eastern Kenya

B. P. Ogillo, B. K. Kisambo, E.C. Kirwa, D.O. Kubasu, and W. N., Mnene

Abstract
A study was carried out at KALRO Kiboko to compare the performance of five Rhodes varieties (Boma, Katumani, Elmba, Ex-Tozi and Pokot) with two range grasses (*Enteropogon macrostachyus* and *Chloris roxburghiana*) under rain-fed for two successive rainy seasons. The study was an effort to make recommendations for appropriate range grass species. The experimental design was a Completely Randomized Design (CRD) with three replications. The parameters measured were plant density, cover, tiller density, plant height and, aboveground biomass. Plant and tiller density, plant height and aboveground biomass were significantly different between the Rhodes varieties and range grass ecotypes. However, percent cover was not significantly different between them. The two range grasses used in the experiment showed better performance in most of the attributes measured. *C. roxburghiana* had the highest biomass

production at 4.6 t/ha, followed by *E. macrostachyus* at 3.4 t/ha. These two range grasses are recommended for pasture production in range areas of similar conditions to KALRO Kiboko under rain-fed conditions.

Effect of Chumvi Kuria and Chumvi Kuria + Selenium Supplements on Performance of Camels and their Potential for Commercialization in northern Kenya

S G Kuria, J Lesuper

Abstract
A study was conducted in Wajir and Tana River Counties of north eastern Kenya to evaluate performance of camels on two types of mineral supplements i.e. Chumvi Kuria (CK) and a variant containing selenium (CK+Se) and, determine their commercialization potential. Design of the experiment was Balanced Randomized Complete Block Design with factorial arrangement of treatments. Each camel was individually fed 200g/day of either CK or CK+Se every morning over a period of 90 days. Milk yield and live weight of calves were measured once every week using graduated jag and tape measure, respectively. The IBM SPSS statistics version 20 was used to analyze the data. In Wajir, camels on CK+Se and CK treatments produced 64% and 61% more ($p<0.05$) milk than controls, respectively. In Tana River, the CK+Se camels produced 9% and 15% more milk than the control and CK camels, respectively. Regarding calf growth in Wajir, the CK+Se calves were 19.1% and 4.3% heavier than CK and control calves, respectively. In Tana River, calves under CK+Se remained heavier than ($p<0.05$) those under CK and control by 26% study concluded that although CK+Se exhibited stronger positive

Cost Benefit Analysis of Natural Pasture Reseeding in Southern Rangelands of Kenya. Proceedings of End of Project Conference, held from 25TH to 27TH April 2017 KALRO headquarters, Nairobi Kenya.

J. K. Manyeki, J.J. Kimutai, B. Kidake, E.C. Kirwa, W. N. Mnene and S. G Kuria

Abstract
Due to environmental, economic and social-cultural factors constraining livestock keepers in ASALs of Kenya, the economic potential of any technological intervention is very important for farmers' decision making process. This study aimed at evaluating the costs and benefits of natural pasture reseeding technology in the southern rangelands of Makueni County using four recommended range grass species (African foxtail, Horsetail, Bush rye and Maasai Love). Allometric technique was adopted to estimate species-specific biomass. Cost benefit analysis was performed by estimating gross margin, cost-benefit ratio and break even yields and prices of natural pasture reseeding technology. The result indicates that the four grass species gave a high percentage gross profit margin and a high cost benefit ratio, an indicator of high return to investment. Income per hectare earned from seed and hay production was high in Bush rye. There was also an increase in tropical livestock unit (TLU) and milk production. The stocking rate ranges increases from 3-7 ha/TLU/year to 0.412-0.695 ha/TLU/year while milk production improves with about 34.8% and 66.4% per day for cattle and goat respectively. The result shows that there is a significant opportunity for the farmers to profit from reseeding pasture. Such an ex post cost benefit

analysis contributes to learning by government managers, politicians and academics about whether reseeding natural pasture is worthwhile. However further research is needed to ascertain the performance of livestock as a result of feeding on these grass species and estimate the associated economic value.

Review of Role of Goat Milk in Household Economy: The Case of Asals of Kenya

J.K. Kimutaia, P.N. Katikua and R.K. Kimitei

Abstract

In the arid and semi arid lands (ASAls) of Kenya, large flocks of non-dairy breeds of goats are found and are reared for their dual purpose roles of meat and milk. This study sought to review the role of goat milk to the small scale goat farmers in the ASALs of Kenya. The study entailed a desktop study of available literature on goat milk. Information obtained was analysed and meaningful conclusions drawn. Results indicate that Kenya has a great potential of improving its goat milk production in the Eastern Africa region owing to the ownership of 46% of the total goat numbers in the region. However, there has been little research focus on the aspect of goat milk especially after the elapse of donor support programs which were involved in the promotion of dairy development projects in various parts of the country. The market for goat milk is poorly developed in the country thus limiting the commercialization of the goat milk enterprise. Nonetheless, research on the efficiency of goat milk reveal that goat milk production enterprise is an alternative livelihood option in the ASALs owing to its ability to boost farmer incomes and improve nutrition among small-scale farmers. However, there is urgent need to address the various limitations to the commercialization of the sub-sector in order to make it a viable enterprise among the goat keepers living in the ASAL parts of the country.

Phenotypic Characterization of Ecotypes of *Cenchrus ciliaris L.* using Morphological Traits

E. C. Kirwa, K. Ngugi, G. Chemining'wa and W. N. Mnene

Abstract

Shortage of feed is one of the major challenges to livestock production in the arid and semi-arid lands (ASALs) in Kenya. Reseeding using indigenous grass species has been widely promoted as an option to address the challenge. The grass seeds used are harvested opportunistically from the natural habitats. Seeds from a grass species harvested from the wild are potentially variable due to environmental differences. Characterization of grass ecotypes provides information on their variations that can be used in development of varieties. A study was carried out to characterize eleven ecotypes of *Cenchrus ciliaris* at KALRO Kiboko research station. The ecotypes were collected from purposively selected sites in the country and planted in the field in five rows of 4 m long. Significant differences in morphological traits were observed among the ecotypes of *C. ciliaris*. Hierarchical Cluster analysis using plant height, stem thickness, leaf length and leaf width traits resulted in two clusters of robust and small sized ecotypes. When flowering traits, time to

start flowering, time to full plot flowering and flowering period, were used two clusters of late flowering and early flowering groups were formed. All Kilifi ecotypes were grouped in early flowering types. This implies that there are early and late maturing ecotypes among the collection and late flowering types were robust while early maturing types were smaller in size. Effect of environment of collection could have influenced the plant size and maturity time of the ecotypes of *C. ciliaris*. The findings indicates that selection for maturity time is possible with *C. ciliaris* ecotypes.

Range Pasture Seed Viability Trends and Factors Affecting it for Selected Rangeland Grasses in the Asals of Kenya

K.B. Kisambo, E.C. Kirwa, B.P. Ogillo, D.O Kubasu and P. Mweki

Abstract

Range pasture seed production for locally adapted species is a venture that is taking root in the Arid and Semi-Arid Lands (ASALs) with efforts from different partners working with farmers with the goal of improving the livestock feed resource base. However, the main challenge has been producing and acquiring quality pasture seeds. The Kenya Agricultural and Livestock Research Organization (KALRO), has been engaged in pasture seed multiplication, capacity building initiatives and offering seed quality testing services for farmers and other organizations. In the past 8 years, work has been done on production and quality testing of seeds of *Cenchrus ciliaris, Chloris roxburghiana, Enteropogon macrostachyus, Eragrostis superba, Chloris gayana var. extozi, Chloris gayana* var. boma and *Digitaria macroblephara.*

Seeds for these grasses harvested from the centre plots and from farmers were tested for viability at the Kiboko laboratory using standard International Seed Testing Association (ISTA) procedures. The results generally indicated low viability for most of the species with *C. roxburghiana,* an important adapted species having a germination percent of 29.74±2.45. Only *E. macrostachyus* had a germination capacity of 86.55±2.30%. Formalization of the range pasture seed market will go a long way in enhancing research, production and a wider understanding the grasses. Further work and research on factors influencing the viability of pasture seeds both at all levels of pasture development and storage in order to improve their viability is recommended.

Participatory Identification and Selection of Collections of *Cenchrus ciliaris* in the Southern Rangelands of Kenya

E. C. Kirwa, K. Ngugi, G. Chemining'wa and W. N. Mnene

Abstract

A study was carried out through Focused group Discussions (FGDs) to evaluate the farmer knowledge and perceptions regarding ecotypes of *C. ciliaris* grass species. Selection of farmer preferred ecotypes was done at KALRO Kiboko research station using the ribbon technique of participatory variety selection. Farmers selected among twelve established ecotypes following their own developed farmer criteria of a good and bad grass. Through FGDs, it was observed that farmers were knowledgeable on the existence of the ecotypes of *Cenchrus ciliaris* whose occurrence was similar in the three different farmers' groups interviewed. Three main ecotypes

were identified by all groups; the small type with purple colored flowers, the robust bluish type and robust green type. The small type with purple flowers was noted as the most preferred by all groups during the FGDs. The ecotype was said to be a heavy seeder dropping a lot of purple colored seeds on the ground thus allowing for its spread and establishment in different habitats. Also, the ecotype is perceived to be tolerant to droughts and heavy grazing. The criteria for selection of ecotypes varied depending on the type of utilization of the pasture. Two of the ecotypes; KLF1 and TVT1 were highly ranked by farmers due to their small stature and thus good for grazing and were perceived to be drought tolerant.

LIVESTOCK STATUS

Table 1: Goat returns

2016/2017 FY GOATS RETURN							
Month	**Births**	**sales**	**deaths**	**Loss/Predation**	**Total**	**%sales**	**%deaths**
July 2016	0	0	3	1	440	0	0.68
August 2016	3	72	5	0	366	0.16	1.13
September 2016	6	16	17	0	339	0.04	4.56
October 2016	48	6	13	0	468	0.01	2.66
November 2016	2	0	17	8	345	0	4.59
December 2016	4	0	2	0	347	0	0.57
January 2017	0	0	0	2	345	0	0
February 2017	0	0	0	0	345	0	0
March 2017	0	0	0	0	345	0	0
April 2017	0	75	2	0	268	0.22	0.58
May 2017	60	28	0	0	300	0.09	0
June 2017	0	6	0	0	294	0.02	0
Total	**123**	**203**	**59**	**11**			

Expected number of animals at the end of the year was 833. Total number of deaths was 59. Therefore loss due to mortality was 7.08%. The deaths mainly occurred in the months of September to November. This was a period when there was severe drought in the country and therefore the goats were at a low level of nutrition. This status compromised the animals' immune system and therefore could easily succumb to diseases. The total number of goats sold during the year was 203 which accounted for 24.37% offtake.

Table 2: Cattle returns

2016/2017 FY CATTLE RETURN							
Month	**Births**	**sale**	**death**	**Loss/Predation**	**Total**	**% sales**	**% deaths**
July 2016	2	0	1	0	583	0	0.17
August 2016	1	23	3	0	558	3.93	0.51
September 2016	1	25	4	0	530	4.47	0.71
October 2016	0	17	6	0	507	3.20	1.13
November 2016	1	0	40	0	468	0	7.87
December 2016	13	0	13	0	468	0	2.70
January 2017	34	0	6	0	496	0	1.19
February 2017	19	0	5	0	510	0	0.97
March 2017	6	0	13	0	503	0	2.51
April 2017	1	18	15	0	471	3.57	2.97
May 2017	2	15	4	0	456	3.15	0.84
June 2017	0	0	5	0	451	0	1.09
Total	**80**	**98**	**115**	**0**			

Expected number of animals at the end of the year was 796. Total number of deaths was 115. Therefore loss due to mortality was 14.45%. The deaths mainly occurred in the months of November and December and also in March and April. This was a period when there was severe drought in the country and therefore the cattle were at a low level of nutrition. The situation was aggravated by invasion of the ranch by illegal grazers offering stiff competition for grazing resources to the Centre cattle. This status compromised the animals' immune system and therefore could easily succumb to diseases. The high mortality rate in November was largely as a result of floods which occurred immediately after the drought and consequently about thirteen heads of cattle drowned. The total number of cattle sold during the year was 98 which accounted for 12.31% offtake. The low offtake realised was caused by poor condition of the cattle as a result of the drought and therefore could not be bought by traders. There were also influx of cattle in nearby markets which raised supply and as a result prices dropped drastically. Traders therefore, opted to go and buy cattle from markets where they could negotiate the prices with the sellers.

CENTRE FINANCIAL REPORT

By D. Y .Mbithi

During the year 2016/17, the finance department consisting of the following were able to execute their collective role of supporting research activities at the Centre. This was through ensuring proper accountability as well as efficient utilization of funds received.

No	Names	Roles
1	Daudi Y. Mbithi	Centre Accountant
2	Erick Tarus	Accountant 11
3	Gibson Ndambuki	Vote controls and Budgets
4	Charles Njeru	Centre Cashier
5	Martin Mwenda	Centre Cashier
6	Joel Mwithui	Finpronet & Financial reporting

Revenue collection during the year dropped from KES. 11,593,780.00 to KES. 8,926,596. This was attributed to animals which were earmarked for sale and were not sold.

The Centre also received KES. 31,235,675 in form of Appropriation In Aid (AIA) from revenue sources and various funding support from GoK and donor community. This included AIA and ASAL-APRP.

Table 2: **Main Centre details on donor funding and GoK in the year 2016/2017 are as presented below;**

Income /Expenditure	**2016-2017**
Revenue	8,926,596
Revenue from non-exchange transactions	
ASAL APRP	24,319,229
AIA	6,916,446
Expenses	
Staff costs	21,864,973
Repairs and Maintenance	9,370,702

HUMAN RESOURCE MANAGEMENT

This report presents the staff position from July 2016 to June 2017. Staff in post is as reflected in the table below. The Institute has three (3) vocational employment. It is anticipated that the number of staff will decrease in number due to those who have retired/dead and have not been replaced.

Staff Establishment as at June 2017

S/No.	Cadre/Specialization	No in Posts
1	Institute Director	1
2	Centre Director	1
3	Research Scientists	10
4	Technical Officer	0
5	Lab Technologist	1
6	Lab Technician	1
7	Senior Technical Officers	4
8	Drivers	6
9	Mechanic	1
10	Admin Support	16
11	Auxiliary	20
12	Vocational Employment	3
TOTAL		**64**

HUMAN RESOURCE SUMMARY REPORT

The Human Resource Development focuses on both training employees for their current jobs and developing skills for their future roles and responsibilities. The Institute continued to coordinate training activities for various cadre in the financial year 2016/2017.

Staff undergoing /on-going long term training during the year

Name	P/No.	Instituttion	Discipline
John K. Manyeki	7283	University of Szged in Hungary	PhD in Economics
Ruth N. Mwangi	3073	Kenya Technical Teachers College (KTTC), Nairobi.	Diploma in Archives and Records Management.

Short term courses attended outside the country or locally during the year

KALRO workshops /training courses

No.	Training	Attendance
1	ASAL – APRP end of project conference at KALRO Hqts 25 – 27 April 2017	9
2	Priority setting forum at Wote from 8 – 11th March 2017	7
3	Field day – Entarara Feb 2017	451
4	Training of Technical Officers on pasture and Natural resource management - Northern Kenya (Samburu, Marsabit, Isiolo, Garisa, Tana River)	21

KALRO Kiboko training of farmers

No.	Training	No of farmers trained
1	Trained farmers on different fodders and grasses – Loitoktok	Three sites Approx. 45 per site
2	Trained farmers on dairy value chain – Loitoktok	30
	TOTAL	**165**

Transfer in

No.	Name	Date Reported
1	Erick Kikorir Tarus	Reported on 3rd March 2016.
2	Gibson Ndambuki	Reported on 4th November 2016
3	Philip K. Langat	Reported on 8th November 2016
4	Nicholas M. Nzioka	Reported on 18th January 2017
5	William Kipsang Maritim	Reported on 11th April 2017

Five (5) staff were transferred in.

Transfers out

No.	Name	Date Reported
1	Eusebius O. Abachi	Reported 9rd March 2017

One (1) staff was transferred out of the Institute during the period July 2016 to June 2017

The following were in vocational training during the same period

S/No	Name	Starting Period	Completion Period
1.	Denis O. Kubasu	1st Jan 2017	31st December 2017
2.	Janet S. Kimutai	14th October 2016	13th October 2017
3.	Joel Muthui	3rd October 2016	September 2017

The Institute still mourn the deaths of Ms Regina Kambua Isika who passed on February and Mr. Robert K. Ngetich who passed on the 18th of April 2017.

PROCUREMENT

By J.Kangethe

INTRODUCTION

During this period under review, the activities in the Section were supported by funds from ASAL APRP and GOK which were coordinated by Mr. Kangethe.

The section was able to execute its collective role of supporting research activities in the Institute. The following officers played different roles as stipulated below:-

No	Names	Roles
1	John Kangethe	Co-ordination of the section
2	Felix Macharia	purchasing
3	Brettar Mwakavi	Stock control
4	Joseph Mbindyo	Ware housing

All staff participated in various activities in the section namely floating of quotations, opening and adjudication, and awarding of the same. The staff also took part in updating of the Assets register, procurement of goods and services, receiving of goods, inspection and issuing to the end user. The head of section also attended two seminars at KALRO Kandara, one on new public procurement and disposal ACT 2006 and on public procurement and Assets disposal ACT 2015. The section also trained 27 interns on procurement functions, procedure and guidelines. The main activities centred on procurements and establishment of a new irrigation plot, procurements and refurbishing the existing water main line and on rehabilitation of the old irrigation plot. The section also carried various other activities like disposal of surplus livestock, purchasing of other breeding stock to improve ours and making various reports like weekly, monthly, quarterly and half year plus the procurement plan. We also held a sensitization program to enlighten the youth, women and the disabled to tender for the supply of goods and services in the organisation.

Constraints

A few issues arose like rehabilitation of the perimeter fence of the open store yard that has fallen, purchasing of protective clothing like boots, helmets. Another problem is the rehabilitation of staff houses, vehicles, motor cycles and the roofing of various offices damaged by monkeys. Also suppliers from around did not qualify and thus we have to travel to Nairobi for most purchases. Once in Nairobi, one has to travel long distances on foot for suppliers are far apart and sometimes using motor cycles.

Conclusion

The year was busy and all went well as planned.

LABORATORIES SECTION

By Peter Mweki: Senior Laboratory Technologist.

Abstract.
The mandate of the laboratories section is to provide laboratory Technical Research Support Services to research scientists and activities at the centre. This mandate continued to be upheld throughout the year, 2016.The section also offered Technical Training Services to students from various tertiary institutions on Industrial field training attachments.

Technical research support services
Different sample materials from various research projects and activities were received in the laboratories for testing, qualitative and quantitative determinations and diagnosis. The data thereby generated augmented field scientific research data by research scientists. The table below shows the types and number of samples received in the laboratories over the year.

Code	Type of sample	Quantity	Type of analysis.
1	Forage	354	Dry matter.
2	Forage seed	98	Viability tests
3	Blood	4	Diagnosis
	Total	**456**	

Technical training services
Students from various institutions of higher learning received technical training on laboratory activities and techniques. A total of nineteen (19) students visited the laboratories during their Industrial field training attachments as shown in the table below:

Code	Student Name	Institution	Course
1	(1) Muema Daniel	Pwani University	Bsc. Agricultural Education and Extension
2	(1) Ms. Kaloki Rosemary Mutheu	Kisii Uiversity	Bsc. Agribusiness Management
3	(1) Mutua Felix Kimeu	Meru University of Science and Technology	Bsc. Crop Protection
4	(1) Veronica Mumbua Kyalo	Egerton University	Bsc. Botany
5	(1) Zipporah Ndunge Ngunzi	Egerton University	Bsc. Agribusiness
6	(4) Ms. Sheila Lullege: Sharon Akumu: Messrs. Lepatei Sitelu and Isaac Kortum	Bukura Agricultural College	Certificate: Agriculture and Community Development
7	(1) Ms. Dorcas Mutunga	Meru National Polytechnic	Certificate: Human Resource Management

Technical Research Support Services and Technical Training Services were the two main laboratory activities in the year 2016. However the section still continued to operate at a technically inadequate level due to limited laboratory equipment. It was therefore hoped that in the fiscal year, 2017, laboratory activities would improve if adequate laboratory equipment would be available.