



**KENYA AGRICULTURAL & LIVESTOCK RESEARCH
ORGANIZATION
ARID AND RANGE LANDS RESEARCH INSTITUTE (ARLRI)**

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Photographs (clockwise): Boma Rhodes Grass, harvesting grass seed, Sahiwal cattle, flock of sheep.

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Abbreviations and Acronyms

AF	Agro Forestry
AI	Artificial Insemination
AIA	Appropriation in Aid
APVC	Agrivultural Product Value Chain
ARLRI	Arid and Range Lands Research Institute
ASAL	Arid and Semi Arid Lands
ASAL-APRP	Arid & Semi-Arid Lands Agricultural Productivity Research Program
ASDSP	Agricultural Sectoral Development Support Programme
CECI	Cenchrus ciliaris
CDW	Cold Dressed Weight
CGIAR	Consultative Group of International Agricultural Research
CHLORO	Chloris roxybburghiana
EAAPP	East Africa Agricultural Productivity Program
ECF	East Coast Fever
ENMA	Enteropogon macrostachyus
ERASU	Eragrostis superba
ES	Estrous synchronization
EU	European Union
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Statistics
FGD	Focused Group Discussion
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
Ha	Hectare
HMF	Hydroxymethylfurfural
IFAD	International Fund for Agricultural Development
ICARDA	International Centre for Agricultural Research in Dry Areas
KAKISWA	KARI Kiboko Welfare Association
KALRO	Kenya Agricultural & Livestock Research Organization
KAPAP	Kenya Agricultural Productivity & Agri-Business Project
KARI	Kenya Agricultural Research Institute
KBWG	Kibwezi Beekeepers Women Group
KCC	Kenya Cooperative Creameries
KEBS	Kenya Beareau of Standards
KEFRI	Kenya Forestry Research Institute
KLMC	Kenya Livestock Marketing Council
KMC	Kenya Meat Commission
KNBS	Kenya National Beaureau of Statistics
NGO	Non Governmental Organization
MoA	Ministry of Agriculture
MOET	Multiple Ovulation and Embryo Transfer
PhD	Doctor of Phylosophy
PPR	Pestis Des Petits Ruminantial
RVF	Rift Valley Fever
SEAZ	Small East African Zebu
UAE	United Arab Emirates

Introduction

The Kenya Agricultural and Livestock Research Organisation, (KALRO) is a corporate body created under the Kenya Agricultural and Livestock Research Act of 2013 to establish suitable legal and institutional framework for coordination of agricultural research in Kenya. The national economic blue print, Vision 2030, recognizes the role of research in technology generation and creation of new knowledge; all of which are vital in national development. Vision 2030 also places great importance on value addition in agriculture and livestock as a means of raising rural household incomes as captured by the sector's driving strategy, the Agricultural Sector Development Strategy 2010-2020 (ASDS). In implementing the second medium term plan, the Kenya Government reformed the National Agricultural Research Systems through creation of the Kenya Agricultural and Livestock Research Organization (KALRO). Its formation was aimed at restructuring agricultural and livestock research into a dynamic, innovative, responsive and well-coordinated system driven by a common vision and goal.

KALRO therefore has the following goals which it aims to fulfill in accomplishing vision 2030:

- Promote, streamline, co-ordinate and regulate research in crops, livestock, genetic resources and biotechnology in Kenya.
- Expedite equitable access to research information, resources and technology and promote the application of research findings and technology in the field of agriculture.

KALRO is a government parastatal charged with the national responsibility of undertaking research and providing solutions to constraints that affect agriculture. The Organization envisions to be a globally competitive agricultural and livestock research organization. The Organization services its parent Ministry of Agriculture, Livestock and Fisheries (MOALF) through generation and dissemination of agricultural and livestock knowledge, innovative technologies and services that respond to clientele demands, for sustainable livelihoods. This is done through research activities conducted at the Organization's various Institutes spread across the country, KALRO Kiboko, falls within the Arid and Rangelands research Institute (ARLRI).

Following the reorganization of former KARI into KALRO with amalgamation with Coffee, Tea and Sugar research foundations through an act of parliament meant to streamline agricultural and livestock research, the Kiboko Centre was upgraded into the headquarter of ARLRI. Kiboko Research Centre, also referred to as simply KALRO Kiboko, was established in 1969 with the mandate to carry out research for sustainable management, utilization and improvement of rangelands for increased range productivity for improved livelihoods. This is now operating within the KALRO goal of integrating livestock value chains fostering commercialization of agricultural enterprises. The focus of the Centre is mainly on the arid and semi-arid rangelands but the Centre also backstops research in other ecozones.

Centre Vision

The vision is to be a globally competitive Centre in developing and transferring arid and range lands technologies that contribute to an improved quality of life for the people of arid and semi – Arid areas,

Centre Mission

The Centre mission is to develop, adapt, disseminate and catalyse adoption of appropriate arid and range lands technologies in collaboration with various stakeholders while conserving the natural resource base.

The arid and semi arid areas constitute over 84% of the Country's land mass and are home to about 10 million or nearly 25% of the total human population.

The vital county statistics and salient features of the areas the Centre research concentrated on prior to the on-going changes are summarized in Table 1 below.

Table 1: Previous Kiboko Research Centre Mandate Counties Land Statistics

County	District	Total land area (ha)	Agric. land (ha)	ASAL (ha)	Farm households	Total population
Taita-Taveta	Taita	1,777,128	582,400	467,164	57,635	246,671
	Taveta	4205.6	33550	838775	17185	67,665
Kajiado	Kajiado	2,190,100	345,000	253,181	96,621	687,312
Makueni	Makueni	800,880	585,200	288,983	144,320	884, 527
Narok	Narok	1793300	994,800	866,250	68,805	850,920
	Total	6,272,940	2,507,400	1,875,578	367,381	1,852.568

The livestock carrying capacity in the dry lowlands (Ecological Zone IV to V) is usually 4 - 12 ha per Tropical Livestock Unit (cow and a calf or its equivalent weighing 250 kg Liveweight). Therefore, even where land appears expansive, there is overstocking especially in the agro-pastoral settings since the average herd size is 7 heads per household against 8 ha of land owned. Further, priority is given to crop production in the agro-pastoral production system. The threat of land degradation and conflict over resources is, therefore, real. The need for interventions to ensure sustainability is high.

Beef is the main agricultural enterprise in the arid and semi arid areas though crops such as barley and wheat are increasingly being cultivated especially in Narok. In Taita-Taveta, beef does not rank among the top five enterprises which are led by dairy. In Makueni, maize production is the main agricultural enterprise despite low yields, low prices and perennial crop failures.

HUMAN INTEREST STORIES

Smallholder sheep farmers in Narok County benefit from KALRO/ICARDA's support on improving sheep value chain



Sheep rearing has been widely promoted in many countries and particularly so in the arid and semi-arid lands (ASAL) as a major contributor to rural development. Sheep production is a way of life for the communities in the lowlands of Narok. The sheep are regarded as 'Automated Teller Machine' (ATM) in the county because of their immense socio economic significance. To the Maasai community of pastoral Narok, sheep are petty cash and is must have for every farmer. In the County, sheep are the most populous livestock, numbering 1.6 million followed by cattle that are slightly below one million.

Sheep are majorly grazers, fast growing and have high twining rate, an attribute that make them combine well with the wheat enterprise practiced in many parts of the County. Their ability to feed on the crop by-products; bean haulms, maize stover, fallen wheat grains and wheat straw make them a major component of the production system.

The International Fund for Agricultural Development (IFAD), KALRO/ICARDA phase II project, set out to work with farmers in improving sheep rearing and products in the county. The project had three facets: improving sheep nutrition, improving sheep genetics and establishment of onfarm sheep finishing for market, developed a model; code named Sheep Research to Business (R2B) to actualize the intervention. The success of the R2B model was dependent on availability of quality fodder, a strategy achieved by the establishment of a two acre (0.75 ha) of Boma Rhode grass in April 2015. The plot served as seed bulking plot for harvesting the seed and expanding to other farms. Sheep weight gain is a factor of feeding, health and breed. In order to improve on the genetics of the indigenous sheep breed, Red Maasai (RM), an upgrading scheme with the fast growing Dorper was initiated. Six pedigree Dorper rams were purchased from a reputable sheep breeding farm in the Country, Gicheha farm, and distributed to the farmers for enhancing the gene pool.



L-R: Sampling biomass of Boma Rhodes grass; flock of Dorper sheep; Pastoralist harvesting Boma Rhodes grass seeds

The sheep onfarm finishing for market component also involved the development of feedlot and other accompanying facilities – sheep pen, hay barn, watering and feeding troughs and shepherd house. The R2B model piloted on-farm lamb feedlot finishing of 134 lambs of 4 months old that were contributed by the participating farmers. A Pilot 10 acres feedlot plot, land donated by one of the participating farmers, was established at Ntumenteni and planted with Boma Rhodes grass sown with wheat for fattening the lambs. The project initially worked with 40 individual farmers, 20 from Ntumenteni and 20 from Olulunga. Each of the participating farmers had also planted 2 acres of improved wheat varieties sown together with boma Rhodes grass seeds, all donated by the project. The straw from the wheat plot was used to enhance nutrition of sheep for the farmer. Even though the project was working with a community based organization (CBO), AntiFGM Poverty and Aids Organization (AFAPO), they willingly allowed none participating farmers to engage in the activities.



Stakeholders-farmer, extension officers and KALRO scientists admire a crop of wheat

The project organized and trained group of farmers on technological packages (sheep management, housing, strategic deworming, treatment, sheep calendar, feed processing and conservation, important sheep data and recording, live weight estimation and closed castration). The first training was conducted on 8th July 2015 involving 4 ladies and 17 men while the second training held on 9th July 2015 with 5 ladies and 17 men participating. Additional farmers were trained later in diverse dates totaling to about 80. A group of 3 farmers was taken to Gicheha farm in Ruiru, Kiambu County, a reputable commercial sheep breeding farm for breeding management exposure. Two open day fora were also facilitated by the project, one being low key open day/leaders consultative forum held on 8/4/2016 and attended by 19 stakeholders inclusive of 13 farmers. This particular event was very important since the leaders developed the road map for establishment of a livestock auction yard at Ntumenteni Centre. The ground work of market yard was laid out and the auction of the finished sheep lambs acted as the first market day of the envisioned livestock market yard. The second event was a major field day held on the day of auction of the finished sheep lambs on 11/4/2016 and attended by over 50 stakeholders including farmers, livestock traders, extension officers, abattoir/butchers, meat processors, scientists, donor representative, political leaders and the local administration.

Indeed, the sheep R2B model is promising to revolutionize sheep enterprise in the study sites even though its initial profitability is minimal because of the immense initial capital requirement.

Nevertheless, the concept is adding value to an important and sustainable alternative source of petty income to rural pastoral areas that will benefit communities by enhancing their livelihoods.



The first lot of 60 lambs sold leaving the feedlot facility



AFAPO officials counting money, proceeds of the first batch of sold out

The public auction for the finished sheep lambs was indeed successful and an initial flock of 60 finished 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. Most of the farmers observed that the new method of sale, live weight basis, was better than visual assessment system. According to the farmers, the finished lambs returned profits of upwards of KES 2300 a piece and took 3 months to finish as opposed to the farmer practice of fattening for a period of more than 3 years. Therefore, the project working with the 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 fattening experiment observed that it was possible to finish and market sheep within a period of 3 months rather than keeping them a year or so as is the normal practice. 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. The AFAPO CBO, based on a written agreement, got a contribution of 10% from the sale proceeds from each animal, amount totalling to KES 61,000. The CBO used the money collected for table banking and as capital for loaning to individual community members to meet family expenses and therefore improving their livelihoods.

Economic profitability of sheep fattening scheme was evaluated through estimating the expected cost benefit parameters (net present value (NPV), gross margin (GM), benefit cost ratio (BCR) and internal rate of return (IRR)) under different scenarios. The estimation were based on an inflation rate of price per annum of 10%, a depreciation on capital asset of 5%, a discounting rate of 11.5% which is the current Central Bank of Kenya interest rate and mortality rate per season of 4.5%. The first scenario is a case whereby the farmer has to buy 132 sheep lamb at the age of 3-4 months for fattening and thereafter sell through auction. In this case the farmer would experience a negative net benefit (NB) of KES 182,043.42 in the first season which is largely contributed by the capital expenditure. The internal rate of return (IRR) of 124.9% indicates that the project will be self-

sustainable in future. This IRR implies that for every one Kenya shillings invested, a return of Kenya shilling 124.90 will be realized which is far much above the Kenya commercial banks interest rate that range from 14-15%. The positive net present value (NPV) of KES 1,406,429.48 that is far beyond zero implies that it is profitable investing in sheep fattening scheme. The benefit cost ratio (BCR) of less than one indicate that the project will not be able to pay in the first season but the BCR above one in the second season implies that the project will be breaking even in subsequent season. The second scenario is a case whereby the farmers come together and contribute 132 sheep lambs for fattening under feedlot system. Under this scenario, the computed cost benefit parameters gave a positive NPV and GM and a CBR above one. This means that the costs invested in the sheep lamb fattening scheme are recovered and high benefits realized. The discounted NPV was far above zero implying that it is worthy investing in sheep lamb fattening for enhanced future benefit with a very high IRR of above 500%.

FARMERS REAP BENEFITS FROM KALRO KIBOKO IMPROVED PASTURE

Dennis Kubasu, Bosco Kidake, Simon Kuria

Mr. George P. Muindi started his fodder production initiative in December 2013 after seeing at a friend's farm (Professor Mbatha). He started with 5 acres of *Chloris gayana* grass (Boma Rhodes) purchased from Simlaw seeds E.A LTD. However, due to low rainfall in his area, the grass did not fully establish to maturity. Based on the advice provided by the manager Sultan Estate farm, a neighbouring 100 acre farm, also engaged in fodder production, he decided to visit KALRO Kiboko where he was trained on sustainable fodder production, its best practices and the suitable species for his farm at Sultan Hamud. He requested for technical assistance during the initial establishment where his 3 farm workers were trained in aspects of land preparation, planting and crop management.

Following the training, George plants 5kg of *Cechrus ciliaris* grass (fox tail) seeds in one acre and harvests an average of 100 to 150 bales of hay weighing 18 kilograms each. His initial establishment (30 acres) in March 2014 took off fairly well considering that he planted during the long rains season which is usually not very reliable compared to the short rains season in ASALs. This made him expand the acreage to 60 during the short rains season of 2015. George now boasts of a 120 acre fodder farm from which in 2015 short rains season, he produced 4000 bales (a significant growth from the initial 30 acres) and sold all of it at KES. 300 farm gate. The farmer initially had the County Government bailing the hay for him at a cost of 20% of the total number of bales but is now using a private partner who is bailing at KES. 70 per bale.

“Unlike maize and beans which are the common crops grown in the area, the range grasses do not need a lot of attention and are hardy”, says Mr. George adding that he only applies farmyard manure and has now increased his herd from 6 dairy animals to 24. “I mix seeds with dry manure when planting using a tractor, spray to curb weeds after two weeks and wait to harvest after four months,” he says, adding that the crop is harvested about three times when the seasons are good. “We are now about 8 farmers engaged in commercial fodder production thanks to KALRO Kiboko, George concludes his story”.



Part of the 120 acre Farm in Sultan Hamud

1.0 RANGE RESOURCE MANAGEMENT & ECOLOGY SECTION

RANGE RESOURCE MANAGEMENT AND ECOLOGY (RRME) SECTION

General Introduction

During the year under review the activities in the section were supported by funds from ASAL-APRP which was coordinated by Mr. Kidake. One of the section's scientist, Mrs. Kirwa continued with her PhD training. The scientists in the section also participated in short duration trainings and also attended workshops and seminars both within and away from the centre. Most of the courses were to strengthen the capacity of the scientists to perform their functions better.

Promotion of pasture and fodder production, and technologies among the pastoral and agropastoral dairy producers in Kajiado County: Experiences from Oloitokitok

Kidake Bosco¹, Kubasu Denis¹ and Kariuki John²

¹Arid and Range Lands Research Institute, KALRO Kiboko

²Beef Research Institute- KALRO Lanet

Introduction

Kajiado County is one of the arid and semi-arid land (ASAL) counties in Kenya. Livestock production remains one of the major economic activity carried out in the region. The farmers derive tangible and intangible properties from livestock. In Loitokitok Sub County, most milk produced in the country originates from small holder farmers with most of them deriving their income from milk sales. It is imperative to understand and improve the productivity of livestock sector by interventions targeting different areas along the dairy/milk value chain. KALRO Kiboko is involved in interventions targeting increased livestock productivity through different initiatives. Currently the ASAL-APRP program, is involved in a project geared towards improving beef productivity in ASALs. As a component of the project, the major focus is increasing the feed resource base through rangeland rehabilitation and pasture improvement work where research is carried out on various fodder and rangeland grass species and out-scaling.

The problem

Livestock productivity in the pastoral and agro pastoral regions is currently undergoing various challenges. Key among them includes changing climatic conditions with the unpredictable weather patterns having a direct effect on feed availability. Despite the availability of various knowledge channels, most farmers do not have access to information on good agricultural practices (GAP) to enhance fodder production and availability. There's inadequate knowledge on pasture establishment, management and even dissemination of pasture and fodder technologies in the southern Rangelands (Mnene, 2006 and Kibet et al, 2006). Since crop production has taken a large part of the productive and higher potential zones in Loitokitok, crop residues play an important role for nutrition of livestock. These are however not well utilized resulting into wastage. For the drier areas where pastoral production remains the main economic activity, rangeland degradation has taken centre stage. Most areas are either bare or heavily infested with bush species hence very minimal desirable forage species and traditional land management practices are collapsing due to changing land use dynamics, climate change and socio-economic factors (Kassahun 2008). As a result, availability of adequate feed to livestock has remained elusive and livestock keepers are adapting different coping strategies in order to mitigate the changes.

Objective

The main objective of this work was to participatory engage with the farmers in conjunction with other players in the fodder value chain in a bid to accelerate the dissemination of appropriate livestock feed technologies in order to increase productivity of the livestock sector in the region.

Materials and Methods

Site

This work was carried out in Loitokitok Sub-county of Kajiado district located in South Eastern Kenya. The region lies at the Mount Kilimanjaro ecological gradient with several categorizations of ecological zones. Rainfall varies from 450 mm in the marginal zones to 1100 mm in the high potential regions.

Approach

The farmers were organized in farmer groups so selected based on the locality and shared common interests and objectives. Generally the team conducted on farm demonstrations, exposure visits to successful sites as well as holding group discussions with farmers using the question-answer techniques. An objective of the demonstrations was to use the mother-baby approach so that farmers are given the opportunity to select suitable fodder varieties of interest and suited to their locality. They would be able to select species that they could plant on their farms to boost feed availability as well as feed security especially during the dry season. In addition, for the more degraded farms and areas, farmers were guided on acquisition of more grass seed and planting materials for rehabilitation of the degraded sites with desirable grasses.

Results and Discussion

Farmers' group dynamics and participation

Participation amongst the farmers varied but depended mainly on level of mobilization and day of trainings and demonstrations. During the different times the teams visited the sites, an average of 50 farmers were present per site. Attendance at one of the trainings is as tabulated in Table 1 by gender.

Table 1: Participation in Trainings during activities of out-scaling fodder and milk technologies in Loitokitok

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

Participation amongst the youth was however poor yet they form a critical part of the population. Above all the good representation represents the thirst for knowledge by the pastoral and agro-pastoral communities.

Knowledge requirements

AS identified in literature, discussions with key informants and through general observations, there were several knowledge needs for the farmers. Generally the trainings and demonstrations focussed on the following aspects.

- Overview on range degradation and rehabilitation
- Types of Pastures and fodders and their potential in the selected area
- Site selection for pasture and fodder establishment

- Land preparation and planting techniques and establishment
- Management of established pastures and fodders
- Basic needs of dairy cows
- Feed quality aspects
- Feed intake and digestibility

Establishment of demonstration set ups

A total of 5 demonstration set ups were established by the end of the year 2015. This includes farms in the regions of Ngama, Entarara, Munyura, Kimana and Rongai. The species established in the plots at Ngama include:- bracharia, sweet potato vines, desmodium, napier grass, boma Rhodes, ex-toziRhodes, fodder sorghums, fodder oats, lupins, lucern, vetch and fodder beets. This site serves as a training and demonstration site for the high potential dairy farmers. In Entarara, the main range grasses *Enteropogon macrostachyus*, *Eragrostis superba*, *Chloris roxburghiana*, *Chloris gayana-extozi* and *Cenchrus ciliaris* have been established. Similarly Munyura and Kimana areas had the range grasses established. However, for Rongai and Kimana, establishment of the different species was poor due to a variety of factors.



Figure 1: Different species of fodder for producing high quality feed for milk production suitable for high potential zones at Ngama, Loitokitok



Figure 2: An establishment of rangeland grasses intercropped in a maize field for producing fodder for livestock in Entarara, Loitokitok



Figure 3: An Establishment of the different range grasses in Munyura, Loitokitok for demonstration purposes

Exposure visits

35 farmers were selected for an exposure visit to Githunguri, in Kiambu County, Central Kenya. This was selected as it is one area where the dairy sector is highly developed including technology adoption. This was an opportunity and channel for the farmers to learn from their compatriots modern technologies in livestock production. Some of the salient points noted about the Githunguri visit include:-

- The Dairy production system in Githunguri is highly advanced (as per the farmer observation compared to Loitokitok)
- Many farmers have planted beneficial agroforestry tree species – limited land but highly intensive systems
- The farmer groups are well organized hence are able to access services like credit and trainings easily
- Better performance species of livestock breeds are kept – high milk producing cattle such as Fressians, Guernsey, Jersey and Crosses.
- They easily access information through pamphlets, local radio programs, private service providers and also County Government help.

Such visits provide a chance of replicating the scenarios, albeit carefully to the locality in order to improve their livelihoods. KALRO and *Inuamaisha* Ltd and their partners therefore need to take a strong lead and guide the farmers to achieve these objectives.

Uptake and adoption of technologies

As reported by Manyeki, 2013, adoption and uptake of range pasture technologies in the southern rangelands is highly dependent on age and education level of household head, land ownerships and affiliation to farmers groups. This was demonstrated in the follow ups after the trainings, where mostly the household heads who mostly owned the land and who attended, were the ones seeking material for planting for the subsequent season. As at the end of the year, seeds from KALRO Kiboko, KALRO Mariakani and even from private farmers in Makueni had been procured by some of the farmers for planting. A follow up indicated that many had planted on their own farms. Figure 4 shows one of the farms where the owner immediately undertook to establish own feed resources on his farm after attending several of the trainings.



Figure 4: A farmer (right) who had adopted pasture and fodder technologies in Munyura, stands in his farm of nappier grass

Constraints faced by farmers and general observations

Some of the constraints enumerated by farmers in the region include difficulties in accessing quality seeds and planting materials. It was noted that most of the KALRO centres which serve as multiplication centres are located far away and most farmers in the region thus rely on agrovets, private individuals and NGOs which sometimes stock required seeds. However they are not very reliable hence farmers and livestock keepers end up reverting to local feed components.

On utilization, many farmers lack the right kind of modern knowledge of feed preservation. During harvesting season, there is too much feed from farms which end up being wasted. It was observed that those well-to-do farmers are the only ones practices such as silage making. There's need to aggressively upscale these technologies to resource challenged farmers in order to broaden the feed resource base as well as feed security hence improve productivity.

Most of the County agricultural staff (Livestock Extension) can only be able to do much if supported by the County governments. However, only projects such as ASDSP and organizations such as KALRO are utilizing their presence. During the discussions some farmers felt that the county government is not doing much on the agriculture front especially concerning livestock production. It is widely reported that high returns in agriculture are noted if extension programs are involved (Taye 2013)

Pastoral areas which are severely degraded comprise a big part of Kajiado County. Most of these areas are heavily infested with undesirable species yet they remain important in livestock production. Such areas include Mbirikani regions and amboseliars where large herds of cattle are found. The challenge therefore remains on how to handle these areas in reseeded and promotion of appropriate fodder technologies as other factors come in play hindering adoption of technologies.

Conclusion

Participatory approaches remain one of the most important means through which adoption of technologies is key. Success is normally reached where a majority of the participants uptake the information and a kind of peer-to-peer reaction or diffusion is achieved. It is anticipated that by the end of the project, the main objective of the larger project – Increased milk production is realized and marketed to improve the livelihoods of the farmers.

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PAPERS IN WORKSHOPS, CONFERENCES AND JOURNALS

Paper presented during NACOSTI conference, 11th to 15th May 2015 at University of Nairobi

Empowering Rural Women through Marketing of Hive Products in Kenya

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Abstract

Over the last decade, the Millennium Development Goals (MDGs), in particular Goal 3 – “to promote gender equity and empower women”, have stimulated increased attention to poor women’s socio-economic empowerment in a range of sectors from formal employment to outsourcing, small business, petty trading and informal, home-based income generating activities. The study was carried out in Makueni County with an objective of assessing the role of women in marketing of hive products and the benefits obtained from their involvement to enhance their livelihood. Households’ survey questionnaire and focus group discussion checklists were the main tools used to gather primary data from the households. At household level, data were collected from 56 women beekeepers in six catchment areas within the county. The result of the study showed that, over 60% of the hives owned by the beekeepers were traditional with an average of 15 traditional hives per sample households, while 40% were langstroth hives. The average productivity of honey was 15.5kg/hive and 24kg/hive for traditional and langstroth beehives

respectively. Honey was the main hive product marketed by the respondents; the average income earned by sample households from sale of honey was Ksh 6,850.00, where 50% of the households earned income within the range of Ksh4501 – 6500. Suggestions for enhancing women's benefits include: greater recognition of informal markets and their position relative to export markets, negotiating power to help with economies of scale, use of modern technologies and support systems such as more use of modern beehives like langstroth which are gender friendly for enhanced productivity. Results demonstrate that rural women can be organized into an effective marketing network that links women honey producers to urban markets and improved honey production practices can generate income and provide nutrition to village families.

Key words: Household, livelihood, beekeeping, empowerment, Millennium Development Goals

Physico-chemical attributes of *Apismelliferahoney* from Southern Rangelands of Kenya

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Abstract

This study was carried out to evaluate the physico-chemical characteristics of eighteen samples of *Apismelliferahoney* from Makueni County, Southern Rangelands of Kenya. The following determinations were carried out: moisture, pH, estimation of Hydroxymethylfurfural (HMF), Proline, Invertase, Diastase, Glucose and Fructose content. The honey samples had moisture in the range of 16.6-21.9%, pH 4.21 - 4.91, free acidity 17.24 - 73.85 meq.kg⁻¹, HMF 0 – 48.45 mg.kg⁻¹, diastase 9.29 - 34.09 Schade units, reducing sugars 71.39 - 90.2% and proline 151.09 – 748.62 mg.kg⁻¹. The physico-chemical results of most (89%) samples were found to be within acceptable range of international honey specifications, Codex Alimentarius Commission Standard and Kenya Bureau of Standard, while a few (11%) of the samples failed to meet the expected standard mainly due to probably inappropriate handling during harvesting and storage of the product. The analysis of HMF showed that majority (94%) of samples were fresh and had not been exposed to a high temperature while moisture content and proline levels of the honey samples from the untrained beekeepers at producer level was high due to harvesting of unripen honey and improper storage conditions which increases the hygroscopy of honey. Generally, the mean of most samples were found to be within the acceptable range of international standards for all of the tested parameters except for HMF and proline. This is an indication of its commercial potential both locally and internationally with little management interventions.

Key words: Beekeepers, honey, hydroxymethylfurfural, quality, standard

Journal paper

E C Kirwa, K Njoroge, G Chemining'wa and WN Mnene. 2015. Nutritive composition of *Eragrostis superba* Peyr and *Cenchrus ciliaris* L. collections from the ASALs of Kenya. Livestock Research for Rural Development 27 (8) 2015.

2.0 LIVESTOCK SECTION

Research projects which were on-going during the year under review included the following;

2.1 Genetic improvement of Small East African Zebu cattle for milk production in ASALs

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Introduction

The Small East African zebu (SEAZ) constitutes about 80% of the total cattle population in Kenya. They are found in virtually all agro-ecological zones, but with higher concentrations in arid and semi-arid lands (ASALs). Compared with exotic cattle breeds, they are relatively better adapted to the harsh conditions that characterize the ASALs. This makes them a major source of livelihood in such areas, which constitute approximately 80% of the Kenyan landmass, albeit their low production potential.

SEAZ cattle have not received much formal genetic improvement and conservation attention, as has their *Bos Taurus* counterparts. Therefore, breeding initiatives for SEAZ have largely been left under the control of the resource-limited agro-pastoralists in the ASALs. This has resulted in inferior genotypes mainly due to inbreeding. Consequently, African indigenous cattle breeds should be conserved because of their economic importance to allow use by both present and future generations.

The project overall objective is to contribute to enhancement of productivity and competitiveness of the dairy sub-sector in ASALs of Kenya through optimization of breeding program for local SEAZ genotypes utilizing modern assisted reproductive techniques such as: multiple ovulation and embryo transfer (MOET); Estrus synchronization and artificial insemination (ES&AI) and Estrus synchronization and use of Bull mounting of breeding cows. The specific objectives are: to optimize and operationalize a breeding program for high milk yielding (>3lt) local SEAZ cattle through strategic use of reproductive technologies especially embryo transfer; to study the reproductive parameters of zebu cattle; and to conserve genetically superior genotypes through appropriate *ex-situ* and *in-sit* conservation techniques. The project is a multi-institution and multi-discipline funded by the Eastern Africa Agricultural Productivity Program (EAAPP).

The work is building on Mr. Mwacharo's breeding work at the centre, KALRO-Kiboko. The entire on-station research herd which also constitute part of the herd of SEAZ cows from Mwacharo's foundation stock is kept at the centre. The centre is also the focal point for all assisted reproduction (MOET, ES&AI and ES&Bull) practical work.

The MOET exercise consisted of 8 cycles, each involving 2 donor cows and 16 recipients (surrogates) and begun in July 2014 and ended in February 2015. Out of the 26 MOET trials, 7 attempts were successful. Six cows calved down by the end of Dec 2015. The ES&AI trial had 15 cases of confirmed pregnancies: 7 SEAZ semen, 6 Boran semen and 2 Friesian semen inseminated cases. The end of December, 2015, 10 of the cows had calved down. The ES&Bull trial had 10

successful pregnancies and none of the cows had calved down by end of December 2015. The entire ART technology will produce 32 calves.

2.2 Integrated Agricultural Production Systems for Poor and Vulnerable in Dry Areas

Katiku, P.N, Manyeki, J.k, and Keya G.A

The International Centre for Agricultural Research in Dry Areas (ICARDA), one of the CGIAR Centres with a mandate for research in dry areas, is implementing an International Fund for Agricultural Development (IFAD) funded project on collaborative basis. The participating countries of the Project are Ethiopia, Sudan, Egypt, Eritrea, Kenya and Yemen. The focus of the project is on upscaling of tested economically feasible, farmer friendly, gender sensitive and climate change smart technologies within a research to business (R2B) model. Kenya Agricultural and livestock Research Organization (KALRO) was invited to participate in implementing Phase II of the project. In Kenya, the rainfed wheat-small ruminant production system in lower Narok is the designated country site. Two cluster sites, Nturument and Olulunga in Narok East/North and Narok south, respectively are the implementation sites.

This is essentially a technology upscaling project within a research to business model for the vulnerable and poor in dry areas. It is a two year project targeting the wheat- range small ruminant livestock system in lower Narok. The Project aims at providing gender responsive best bet technologies that are climate change-proof, user friendly and inexpensive to about 5,000 beneficiaries of smallholder farmers in order to improve their livelihoods. The goal of the Project will be to enhance smallholder farmers' livelihoods in the Nile Valley and Sub-Saharan Africa Region through innovative research to business (R2B) platform. The objectives of the Project are: (a) Develop profitable and climate change-proof packages/models of tested and proven technology options. (b) Facilitate the institutional and policy environment for an accelerated scaling up of these technologies. The activities of year one will mainly involve the development of the model as an intervention package while year two will concentrate on up scaling of the intervention package

The activities of year one mainly involve the development of the model as an intervention package while year two will concentrate on up scaling of the intervention package. The sheep component involves the development and commercialization of a research to business (R2B) model for onfarm fattened sheep. The R2B model will involve on-farm lamb feedlot finishing of 200 lambs of 4 months old that will be fattened for 3 months and collectively marketed under a public auction. The 200 lambs will be contributed by the participating farmers. A Pilot 10 acre feedlot plot will be established at Nturument and planted with Boma Rhodes grass undersown with wheat for fattening the lambs. The project will initially work with 40 individual farmers, 20 from Nturument and 20 from Olulunga. The participating farmers will each plant 2 acres of improved wheat varieties donated by the project. The project will also provide 6 breeding rams, Dorper, to farmers for genetic improvement of their local sheep. Fattening of the sheep started in December 2015 after harvesting of the wheat in the feedlot plot.

Three innovation platforms to train farmers on improved sheep husbandry practices-feeds and feeding, strategic deworming and better housing -were conducted during the period ranging from July to December 2015. The baseline survey was singled out the major issues in sheep value chain in the study sites of Narok as;

- ❖ Limited knowledge on general sheep husbandry

- ❖ Poor genetics (breeds and breeding)
- ❖ Finishing of sheep for market took more than 3 years
- ❖ Lack of sheep management calendar
- ❖ Poor sheep housing
- ❖ Inappropriate nutrition of sheep (feeds and feeding)
- ❖ Poor and expensive helminth control practices for sheep
- ❖ Lack of written record keeping for sheep enterprise.

Results/Milestones

- Technical report of baseline conditions to benchmark and document the existing production practices was developed.
- A R2B model of on-farm sheep finishing developed
- Quality seed donated to farmers
 - i) 30 kg of Boma Rhodes grass seeds
 - ii) 7 Dorper Rams
- 10 acre of forage developed
- 2 acres of seed bulking- Boma Rhodes developed
- Innovation platform conducted/farmer training workshop; 16 farmers trained on improved sheep husbandry practices-feeds and feeding, breeding, strategic deworming and better housing

Conference papers and corresponding abstracts

- i) Katiku PN, Manyeki JK, Nginyi JM, Kimitei RK, Amboga SS, Ogillo BP, Njau p, Mahagayu CM, Mnene WN, Keya GA, Kibet PF. 2015. **The status of smallholder sheep production in selected Arid and Semi-arid Areas of Narok County, Kenya.** Paper presented at the Animal Production Society of Kenya (APSK) scientific symposium in April 21-23, 2015 at Sarova Whitesands Beach Resort & Spa, Mombasa.
- ii) Nginyi J.M., Katiku P.N., Manyeki J.K., Keya G.A., Kibet P.F. 2015. **Helminthoses and other disease challenges of sheep in the integrated livestock and wheat farming systems of dry areas of Narok County, Kenya.** Paper presented at the Kenya Veterinary Association (KVA) scientific symposium in April 21-23, 2015 at Busia, Kenya

2.3 Conference Papers

2.3.1 The status of smallholder sheep production in selected Arid and Semi-arid Areas of Narok County, Kenya.

Katiku PN^{}, Manyeki JK¹, Nginyi JM², Kimitei RK¹, Amboga SS⁵, Ogillo BP¹, Njau p³, Mahagayu CM³, Mnene WN¹, Keya GA⁴, Kibet PF⁴*

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Abstract

Sheep is a major component of the pastoral livestock production system and contributes to gross national product through meat, wool and skin exports, to food production by converting roughages into meat and to rural employment. There is an increasing demand for mutton for domestic and export meat market. A study was conducted in the pastoral smallholder sheep production sites of Olulunga and Nturumeti, Narok County. A purposive sample of 32 households, five key informant interviewees and four focused group discussions were conducted in November of 2014 to characterise smallholder sheep production and identify gaps in various segments of the value chain in the county. The results indicated that sheep are mainly owned and reared by male gender (81%) on average 7.5 hectares of land. Main sheep breeds; Red Maasai, Dorper, Merino and crossbreds were kept but preferred breeds were Dorper, Red Maasai and their crosses. The sheep main source of feed was natural grazing (100% of respondents) with shortages being experienced in the dry season by all. Only 20% of respondents conserved surplus forage. The major feed shortage coping strategy was by practicing pastoralism and use of purchased forages. Major challenge were sheep diseases and shortage of feed during the dry spell. There was moderate (48%) usage of wheat straw and other crop residues even though most of the households grew wheat, maize and other pulses. Majority of the households, 75%, were not aware of sheep innovations and those aware, majority, 50%, learnt from fellow farmers and 25% from non governmental organization (NGO). The feeding regime was unimproved pasture grazing whose sustainability is questionable under the current threat of climate change. The results indicate that the indigenous breed of sheep, Red Maasai, is still popular in the county. The research, extension as well as the marketing segments of the chain were relatively poorly involved resulting into inefficiencies. Indeed, the infusion of modern production innovations, technology and current marketing strategies is key in improvement of the sheep value chain.

Key words: ASAL, smallholder, sheep, Narok

2.3.2 Small Ruminant Value Chain: Assessment of the functionality of chain actors in pastoral and agro pastoral systems in semi arid areas of southern Kenya.

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Abstract

An assessment of the small ruminant value chain (SRVC) in pastoral and agro pastoral systems in semi arid areas of southern Kenya was conducted in 2010. Single subject interviews and focused group discussions (FGD) with relevant players was conducted using a structured check list. The main actors were producers, input suppliers (agro veterinary shops) and traders (mainly middlemen). Supportive institutions and processors were not strongly functioning. The producers, represented by agropastoralists and pastoralists, were keeping a mixture of sheep and goats even though the pastoralists kept large herds of sheep than the agro pastoralists. Extension service providers as well as research and development institutions were not regularly interacting with the main chain actors, producers and middlemen. Marketing information and marketing institutions were rarely available. Disease challenges (helminthosis), poor genetics and lack of input supplies institutions at the grass root were among the constraints reported by small ruminant actors in the southern rangelands of Kenya. The up grading strategy of SRVC in the southern rangelands of Kenya ought to involve improving the efficiency and functionality of the chain. There is need of encouraging the formation and involvement of Community based organizations such as cooperative societies that can also double as financial provision institutions. Similarly, formation of marketing groups can be useful in common bargaining marketing arrangements for products. The disease challenges can be solved by research and extension service providers improving their visibility at the grass root

Keywords: *Actors ASAL chain of small ruminants Kenya*

2.3.3 Use of assisted reproductive techniques in breeding of small EA Zebu cattle at KALRO, Kiboko.

Authors: Kihurani, D.*; Mburu, J.^; Kosgei, I.†; Mbuku, S. ‡; Ngigi M.^; Katiku, P. # and Wambulwa, L. #

Institutions: *University of Nairobi; ^Egerton University, †Laikipia University, KALRO ‡Lanet and #Kiboko.

Abstract

Multiple Ovulation and Embryo Transfer (MOET) as well as Estrous synchronization and Artificial Insemination (ES & AI) are two assisted reproductive techniques (ARTs) that were used in a small East African Zebu (SEAZ) herd. The herd was maintained at the Kenya Agricultural and Livestock Research Organization (KALRO) facility at Kiboko, Makueni County, where the techniques were utilized for genetic improvement. The cattle were selected on the basis of a relatively high milk yield, fertility as shown by regularity of oestrus and calvings, adaptability to

the semi-arid environment, and good health. Four MOET programs were performed, each with 4 donors and 16 recipient cattle. In addition, one ES & AI program was done using 30 SEAZ. From the MOET programs 23 transferable embryos were obtained and implanted into suitable recipients. Pregnancy diagnosis was thereafter done using ultrasound, out of which 8 were confirmed pregnant. Of this lot, 1 calf has already been born. The cattle on the ES & AI program have also been examined and a further 6 confirmed pregnant. Challenges encountered during these programs included drought periods with inadequate pasture and water, competition for the available pasture with illegal cattle and camel grazers, irregular concentrate supplementation due to funding constraints, and a Foot and Mouth Disease outbreak. Nevertheless, these results demonstrate that ARTs, particularly MOET which is being performed for the first time in SEAZ in Kenya, can be used successfully. This exercise is also creating a SEAZ nucleus herd with heifer and bull offspring which can be availed to local farmers for breeding.

Key words: *Estrous Synchronization, Multiple Ovulation Embryo Transfer; Small EA Zebu.*

2.4 Research Proposals

2.4.1 Comparative performance of three range grass species and *Brachiaria Mulato II* on growth rate of Small East African Zebu entire male weaners

Bii, J.C

Introduction

Grass will remain to be the main feed for cattle in the Kenyan arid and semi-arid lands (ASAL) for a long time to come. This is because other sources of feed are expensive and may not be afforded by majority of the farmers. In the ASAL are found several species of grasses including *Cenchrus ciliaris* (CECI), *Eragrostis superba* (ERSU) and *Chloris roxburghiana* (CLRO). These grasses are utilized mainly in form of standing hay. Whereas proximate analysis has been done by several authors to determine %CP, Ash, %DM, %acid detergent Lignin, and %Acid Detergent fibre, it is also important to study the animal performance when fed on these grasses.

Justification

There is a need to improve productivity of range livestock in order to boost farmers' household economy and consequently improve their livelihood. The best way to do this is to improve the quality of feed especially grass since it is the cheapest feed for ruminants in the ASAL. There are several species of grasses in the ASAL and it is necessary to identify the high yielding ones in order to improve ruminant productivity.

This can be done by determining the quality (nutritional analysis) and quantity (DM yield) of the grasses through laboratory analysis and feeding trials. A study of *Bracharia Mulato II* nutritional characteristics will assist in boosting range cattle productivity.

Objectives

Overall objective

- ☐ To improve the productivity of the Small East African Zebu (SEAZ) in Arid and Semi Arid Lands of Kenya.

Specific objectives

- ☐ To compare three range grasses and *Bracharia Mulato II* on growth rate and feed intake of SEAZ entire male weaner calves.

- ❑ To determine the Cost: Benefit ratio of three range grasses and *Bracharia* MulatoII on growth rate of SEAZ entire male weaner calves.

2.4.2 Effects of selected supplements on beef cattle productivity and rumen microbiology in Makueni County

Bernard Korir

During the year under review my proposal for PhD research was finally approved by the Faculty Board of Post Graduate Studies in the Faculty of Veterinary Medicine at the University of Nairobi. The title of the proposal is 'Effects of selected supplements on beef cattle productivity and rumen microbiology in Makueni County'.

The overall objective of the study is to assess the suitability of *Brachiaria* mulato II, Cassava leaf meal and Azolla as supplements to cattle for increased growth rate in agro-pastoral production systems. It is part of the ASAL APRP Beef Mega Project.

The Specific objectives are:-

1. To collect baseline data on the yield, and chemical composition of *Brachiaria*, leaves of popularly grown varieties of cassava and *Azolla* in Makueni County.
2. To formulate and evaluate feed supplements from *Brachiaria*, Cassava and *Azolla* for grazing beef cattle in Makueni County.
3. To determine the influence of these feed supplements on rumen microbial characteristics and fermentation patterns in beef cattle.

As part of the preparation, *Azolla* which is one of the feed supplements was collected from the Mwea Integrated Agricultural Development (MIAD) Centre in Kirinyaga County. During the same period, Cassava leaves were collected from the Cassava multiplication fields at KALRO Kiboko. *Brachiaria* grass hay was also harvested and stored. All these were in preparation for the feeding trials which was to be carried out at a later date.

Arrangements were made to carry out the microbial study at BecA-ILRI Hub. The nutritive value of the experimental feeds was also carried at the KALRO Dairy Research Institute Naivasha.

The feeding trial will be carried out using Small East African Shorthorned Zebu heifers and steers. The animals will be taken out for grazing during the day as is usual in the rangelands. In the evenings, the animals will be kept in groups according to their treatments in separate night sheds. The feeding experiment will be a completely randomized design (CRD) with six treatments and each treatment will comprise of four animals which will be group fed. The animals will be weighed every 2 weeks to determine weight gain.

The feeding experiment will target the long dry season when quality of available forage is expected to be deficient in available nutrients such as crude protein (CP) and this has an antagonistic effect on microbial protein synthesis. Rumen liquor samples from the experimental animals will be collected by inserting a flexible rubber pipe into rumen via mouth and polythene tube then introduced through the flexible pipe to suck the liquor from the rumen with the help of plastic syringe (60 ml capacity). Weighed samples of rumen liquor for the microbial study will be taken from the experimental animals before feeding. The samples will be taken immediately to the laboratory, where the samples will be freeze-dried, ground and stored at -72°C to await molecular study.

3.0 SOCIO ECONOMICS AND APPLIED STATISTICS

By: Manyeki JK

3.1. Introduction section

Preamble

Socioeconomics and policy development unit was created in the Arid and Range Lands research Institute, Kiboko Research Centre on 2014. This was after the amalgamation of four research institution namely KARI, KETRF, KESRF and KECRF. The **Purpose of establishing SEDP unit** was to generate and promote use of socioeconomics and applied statistics knowledge and information that respond to clients' demands and opportunities during development and adoption of appropriate agricultural knowledge, information and technologies. This is a cross cutting unit which addresses socio-economic, policy and applied statistics issues in all priority value chains in collaboration with other programmes. SEDP research activities are implemented in all KALRO Institutes and Centres and comprise two sub-units: Socioeconomics and policy development, and Research methods and analytics.

Vision, Mission and the main objective of the unit at ARLRI Kiboko Research Centre

The vision of the section is to be an effective and dynamic programme that ensures KARLO-Kiboko centre develops and disseminates market oriented, economically viable, socially acceptable and scientifically sound technologies and information within an enabling policy environment, thus contributing to positive impacts of agricultural research. In order to realize the above vision, the mission of the section is therefore to generate and provide to KARLO scientists and managers appropriate socio-economic information and applied statistic inputs required during the development, adaptation and adoption of agricultural technologies. The main research programmes undertaken by the unit in collaboration with other section are;

3.1.1 Socioeconomics and policy development

Programme formulation (Priority setting)

The broad objective of priority setting is to arrive at areas of intervention that would have the highest impact at farm or community level. Programme formulation/priority setting involve characterization and diagnosis of farming systems and identification of biophysical and social, cultural, political, economic and environmental constraints limiting agricultural production. It therefore involves value chains analysis and prioritization Agricultural Product Value Chains (APVC), reviewing and prioritizing proposed projects at the centre/programme levels and ex-ante analysis (impact assessment) of R&D projects

3.1.2 Social, gender and participatory research methods

This involves analysis and incorporation of social and gender dimensions in planned on-going/completed R&D project, assessment of social and cultural dynamics in groups for R&D project, ex-ante and ex-post impact assessment of proposed/completed R&D projects on social indicators such as food security, poverty alleviation/income generation, gender equity, health/nutrition, education, empowerment of marginalized communities/vulnerable groups level of community participation in R&D projects, development /testing of participatory research methods/approaches and assessment of their effectiveness and efficiency and more specifically aiming at;

- Mainstreaming gender issues in R&D both in the organization and research projects levels
- Social mobilization and social-cultural considerations in agric. R&D
- Social benefits in from R&D interventions

- Gender concerns in agricultural development and its status
- Involvement of youth in agriculture
- Mechanisms to enhance participation and creation of effective partnerships with various stakeholders in agric R&D

3.1.3 Marketing research, analysis and development

This involves analysing of the structure, conduct and performance of different agricultural inputs/output markets, assessment of marketing costs and margins for various players along Agricultural Product Value Chains, development and utilization of appropriate market information systems, organizing producers into producer/marketing groups and assesses their effectiveness and development of approaches to link farmer(s) groups to input/output markets

- Focus on issues of marketing and markets development for agricultural inputs and outputs,
- Individuals and institutions involved in marketing
- Regulatory mechanisms
- Imports and exports (what inputs, what outputs)
- Support to markets
- Market organizations/associations
- Pricing and price determination...

3.1.4 Policy research and analysis

This involves conducting policy research and analysis studies for key agricultural policies, including ex-ante and ex-post impact assessment of various policy, development of policy briefs for policy makers from the different studies, participation in policy formulation processes, especially under the new constitution and organizing policy discussion for a to disseminate research findings

- Review of key policies deriving the agricultural sector
- Policy formulation processes and participation of the citizenry
- Policies on production, regulation, consumption
- Policies on access to inputs (including technologies;) inputs, e.g. water, fertilizers, seeds, credit, labour issues)
- Policies on public/private sector investments in the agricultural sector
- Analysis of policy incentives and disincentives,...

3.1.5 Economic analysis and Impact Enhancement

Generate information for better understanding of food systems and competitiveness and commercialization of various APVC in different regions

- Catalyze the adoption of technologies to enhance food security, incomes and environment conservation
- Increase household consumption of locally-produced foods to improve levels of nutrition and health
- Focus on the economics of agricultural production (including costs of production, returns to investments, agribusiness development) of agricultural commodities...access to technologies and to agricultural inputs, how are impacts of R&D to be assessed)

3.1.6 Adoption studies

This involves assessment of the levels of adoption of released technologies and the factors influencing adoption at different stages of technology generation, and adaptation for wider usage (upscaling). This stage is done together with stakeholders and includes identification of the target and control samples in clients in the intervention areas as per the baseline, developing a data collection instrument to gather the relevant data on different variables and in particular the key

performance indicators as established in the baseline, data collection and analyzing the data and marking inferences/conclusion

3.1.7 Research methods and analytics

The biometricians and/or statisticians are involved in the designs of experiment/surveys, data analysis and interpretation of results, capacity building of scientists in use of statistical packages, and development of methodologies and more specifically assist in:-

- i. Collection, collation, storage, retrieval and use of agricultural data for planning
- ii. Designing the custodians of such data
- iii. What methods to use in data collection
- iv. Level and use of appropriate statistical methods in agricultural research
- v. Capacity in use of statistics in research and capacity building in statistics for research and planning
- vi. Assess and capacity on use of various statistical software in analytics
- vii. Policies on data collection, access storage and use....

3.2 SECTION II

3.2.1 PROJECT CARRIED OUT DURING THE YEAR UNDER REVIEW

During the year under review the following project were carried out in the section

KAPAP Projects

1. Enhanced marketing of beef cattle, sheep and meat goats through development and promotion of appropriate feeding strategies in Southern Rangelands of Kenya

In addition, the section participated in the following projects;

1. KASAL and KASAL_APRP
2. ICARDA Phase II.

3.3 Journal papers published during the year under review

Journal paper in LRRD journal

Economic analysis of natural pasture rehabilitation through reseeding in the southern rangelands of Kenya

**J K Manyeki, E C Kirwa, P B Ogillo, W N Mnene, R Kimiti, A Mosu and R Ngetich
Kenya Agricultural and Livestock Research Organization, Arid and Range Lands Research Institute, P.O. Box 12 – 90138, Makindu**

manyekijk@yahoo.com

Abstract

Of late, there has been a national effort to rehabilitate the degraded area of arid and semi-arid lands (ASALs) of Kenya through disseminating reseeding technology. The technology was selected based on its early attempts as a means of rehabilitating degraded natural pasture in Kenya that reported encouraging success. Due to geophysical constraints, severely resource constrained livestock keeper and some socio-cultural factor prevalent in ASALs of Kenya, the economic potential of reseeding technology in terms of outputs, costs of production and profit are very important factor for farmers' decision making which has received little attention. This study aimed at evaluating the economics of reseeding natural pasture in the southern rangelands of Makueni County using the range grass species. The recommended grass species were *Cenchrus ciliaris*,

Chloris roxburghiana, *Enteropogon macrostachyus* and *Eragrostis superba*. Based on cost benefit analysis, all the grass species gave a positive net present value and gross margin and a cost benefit ratio above one implying that the costs invested in the improvement of pasture through reseeding are recovered and benefit realized. Income per hectare earned from seed and hay production was higher than that obtained from maize production. There was also an increase in tropical livestock unit (TLU) and milk production. For a year long proper use factor of 50%, safe stocking rate varies from 1.44 to 2.43 ha/TLU/year with *Chloris roxburghiana* recorded the highest while *Enteropogon macrostachyus* the lowest.

Keywords: cost benefit ratio, economic, gross margin, natural pasture improvement, net present value, tropical livestock unit

3.4 COLLABORATION WITH OTHER SCIENTIST OR DEPARTMENT

Currently collaborating with KALRO Kiboko, Njoro and Headquarter scientists in implementation of IFAD-ICARDA Funded Project Phase II

3.4.1 Project Title: Improving Integrated Agricultural production systems for the Poor and Vulnerable in semi-arid Narok, Kenya

National project Coordinator: Dr.Keya

Project Investigators: KibokoTeam: Mr.Katiku, Dr.Nginyi and Mr. Manyeki

NjoroTeam: Mr.Mahagayu, Mr Mbanda

Specifically implementing the following activity in the project

- Confirmation/validation of Economic profitability and gender sensitivity of selected small ruminant technological options (through further analysis of ex-ante and ex-post)

3.5 Proposal developed and secured funds

3.5.1 Galla Goat business plan

Title: KALRO Kiboko, Goat Multiplication. Financial and Sales Plan from FY 2015/16 to 2018/2019

By: Manyeki JK, Muthiani EN, Apondi A, Bii JC, Wambulwa L and Kuria SG

June 2015

Executive Summary of the plan

KALRO/ARLRI Kiboko Research Centre has a ranch which has been used in the past for goat and cattle production mainly for research. The Centre at present has a total of 453 Galla goats which were purchased under the Kenya Agricultural Productivity Program (KAPP) from Garissa in 2006 with an objective of multiplying them for selection of both meat and milk breed. However, the flock build up has been slow and funding for the research stopped. The Centre has had to maintain them by sourcing for resources as the Ksh. 330,000 generated from the sale of culled does and bucks is not enough. The Centre in 2014 developed production objectives for the goats namely: production of breeding bucks for sale at one year in the short term at 35 kg live weight; production of meat goats for the national market at one year at 35 kg live weight; and production of restocking does in the long term to be sold at one year old.

The management has developed a multiplication plan to enable it achieve the production objectives. Noting that the ranch can support 1500 goats, the multiplication plan outlines the, vision, mission, production capitalization and sales and financing plan. The Centre vision on goat

production is to be a leading organization in provision of quality breeding bucks and meat goats to stakeholders in the rangelands of Kenya. The Centre mission is to establish a robust management system that will ensure the use of clearly defined breeding and feeding plan as well as performance recording. The ranch will endeavour to promote the use of quality breeding bucks by the pastoral communities and consumption of the high quality goat meat for improved nutrition as well. The stakeholders will be encouraged to give feedback to the Centre as a basis for future research on the Galla goats.

The Centre decision to get into the production of breeding bucks is informed by the increasing request by stakeholders especially farmers and NGOs. The production of meat goats is informed by the increasing demand for red meat which is projected to double by 2025. The Centre is likely not to have a major challenge in marketing in the near future though this may change with increasing adoption of technologies by the pastoral communities.

The Centre proposes to start with 138 does plus 250 others to be bought from Garissa to accelerate the rate of flock build up. The ranch will adopt two breeding seasons per year. The production parameters used are 90% kidding rate and 5 % pre-weaning and 5% post-weaning mortality rate respectively. The ranch will reach the maximum carrying capacity for goats in December 2017 and will be able to start selling breeding does besides the breeding bucks and meat goats.

The enterprise will generate revenue from the sale of breeding bucks, meat goats, manure and milk in the short term and breeding does in the long run. All the live goat products will be sold at one year old or at 35 kg live weight at an estimated production cost of Ksh. 1,809.4 per unit.

The Centre will finance the plan through the projected sales and a loan. In May 2015, the centre evaluated 58 bucks and 49 culled does from its existing flock and is waiting for authority from Director General KALRO to sale. The sale of the 107 goats will generate Ksh, 671,400, sale of manure and milk and the bucks used for breeding will generate an additional 89,820 giving an income of KSh. 701,220 in the first six months. Estimated expenses include the buying of 250 does, repair and construction of a maternity *boma* and purchase of 10 breeding bucks amount to Ksh. 2,097,648. The Centre will request for a loan from Director General KALRO to meet the Ksh. 2,097,648 expenses in the first breeding season. The amount will be repaid in full by end of June 2018. The cash flow is in Table 3 while the production and sales plan are in appendices 1 and 2. The excel file is attached as an object at the end of the document for reference.

Goats reproduce fast and have a high turnover and may probably hold the key to improving livelihoods in the ASAL under the changing climate due to the predicted increase in woody species. The Centre will be able to contribute to the achievement of the government goals of increasing agricultural production by providing quality inputs to farmers.

3.6 CONSTRAINTS OF THE SECTION

- The section is understaffed as currently has only one Research Officer and one Assistant Research Officer making it very difficult in addressing the core business of the section.

4.0. KIBOKO RANCHING UNIT

By Levi M Wambulwa

4.1 Summary

The centre livestock herd consist of goats and cattle. The goats are mainly of Galla goat breed while the cattle are largely the Small East African Zebu (SEAZ) cattle. Both cattle and goats are kept on the ranch for commercial and research purposes. The two species of livestock on the ranch were experimental animals that were handed over to the Centre management at end of projects. They are maintained on natural pasture as the main feed source. Water is obtained from Kiboko and Makindu springs. Funding is from the Government of Kenya (GOK). The labour force is from both casuals and permanent staff. The cattle and goat herd and flock structure are as shown in Table 44 and 45, respectively. The resources used to maintain the herds are shown in table 46.

Table 44: Centre Goat herd

2015 GOATS RETURN				
Month	Births	sale	death	Total
January	4	0	3	545
February	7	0	11	450
March	5	0	2	453
April	0	0	0	453
May	1	0	1	453
June	0	0	1	452
July	32	79	2	403
August	138	11	7	522
September	2	0	10	514
October	1	0	53	462
November	9	0	24	444
December	2	0	5	441
Total	201	90	119	Average 466/month

Table 45: Centre cattle herd

2015 CATTLE RETURN				
Month	Births	sale	death	Total
January	6	0	4	543
February	3	0	4	543
March	6	0	2	548
April	2	0	1	549
May	4	0	0	553
June	2	1	0	554
July	0	5	21	558
August	3	0	0	552
September	2	0	2	552
October	3	9	2	544
November	4	4	10	534
December	16	0	0	550
Total	51	19	46	AVER. 548/month

Table 46: Resources used to maintain centre goats and cattle herds (2015 Drug ,Acaricides &sprays and other supplies for production)

Item description	Quantity	Unit price kshs	Cost Kshs.
Tactic Acaricide lts	108	1190.40	128,563.20
Penstrep 100mls bottle	23	380.00	8,740.00
Multivitamin 100mls bottle	32	250.00	8,000.00
Alamycin LA 100mls bottle	27	268.50	7,249.50
Tylosin 100mls bottle	12	480.00	5,760.00
Delete 40mls bottle	460	270.00	124,200.00
Ectomin lts	1.1	1000.00	1,100.00
Dewormer	1.5	4800.00	7,200.00
FMD Vaccines	600	120.00	72,000.00
CCPP Vaccine	500	12.00	6,000.00
Cotton wool rolls	4	270.00	1,080.00
Needles G18	154	5.00	770.00
Healing oil cans	3	350.00	1,050.00
P.O.P rolls	10	100.00	1,000.00
Milking salve 250g tin	1	200.00	200.00
Dairy meal			0.00
Mineral salt 5kg package	20	350.00	7,000.00
Mollasses	2	600.00	1,200.00
Disseptoprim	80	20.00	1,600.00
Total			382,712.70

4.2 Disease control

Routine dipping (using Amitraz acaricide) on every Tuesdays at boma 1C for cattle and hand spraying of goats weekly was instituted, although there were inconsistencies in supply of acaricide and shortage of water due to breakage of water pipes. Calves and all goats were dewormed using Albendazole 10%.

Trypanosomosis cases were noted to increase on the farm especially in October to December of the year under review. Prophylactic treatment was done. Other cases of bacterial, protozoan, fungal, rickettsial were successfully treated as they occurred.

4.3 Feeding and Watering

Proper grazing regime was difficult to enforce because of the heavy bush encroachment. Some areas with *Acacia mellifera* and *Commiphora* shrubs excluded grazing animals and inhibited good pasture undergrowth. Ranch animals relied on non-improved natural pasture as only and main feed. Throughout the year there was enough feeds.

There were instances of wild fires in between October and December, hence, there was high competition for feeds on the farm for both agro and pastoralist farmers who had moved into the ranch from as far as Kitengela and Loitokitok seeking pasture and water.

There was rationing of water to the livestock boma due to drastic reduction in water volume at the Makindu spring.

4.4 General livestock management and practices

Identification of stock

Calves and kids were identified by tagging within 7 days of birth. Weaner calves were branded at weaning time.

4.5 Ranch Infrastructure

For many years, Bomas, dips, water reservoirs, firebreaks and farm roads have not been rehabilitated intensively apart from minor repairs. Within the year, seven bomas were used for livestock and other 2 remained vacant but for emergencies in case others breakdown.

Amongst three plunge dips, one for cattle was in use at boma 1C. Amongst 4 Concrete water tanks only two provided minimal services i.e due to old age they do leak. For the firebreaks and road networking the ranch, they remained ungraded.

4.6 Ranch security

The ranch was heavily invaded by wildlife especially elephants from Amboseli that caused frequent damage to water pipes, farm structures and vegetation. Illegal herders with camels, cattle, sheep and goats competed with KALRO livestock. In addition, the trespassers illegally harvested trees and hardcore. The Centre management involved County Administration to address the vice.

4.7 Constraints

The Ranch was faced with challenges such as;

1. Lack of a Veterinary Officer to guide on herd health of livestock.
2. Sometimes lack of prompt means of transport to attend to livestock sick cases.

3. Delay in supply of drugs and acaricide.
4. Illegal grazers invading the ranch in great numbers and introducing diseases and depleting pastures for Centre Livestock.
5. Frequent lack of water for livestock due to breakage of water pipes by elephants and delay in purchase of replacement materials.
6. Lack of sufficient funds to purchase supplements to mitigate on malnutrition.
7. Predation by wildlife especially on small stock.

5.0 ACCOUNTS

By A. M .Apondi

FINANCIAL REPORT

During the year 2015/16, the finance department consisting of the following were able to execute their collective role of supporting research activities at the Kiboko Centre. This was through ensuring proper accountability as well as efficient utilization of funds received.

No	Names	Roles
1	Andrew Apondi	Institute Accountant
2	Daudi Mbithi	Centre Accountant
3	Eusebiuos Abach	Vote controls and Budgets
4	Charles Njeru	Centre Cashier
5	Martin Mwenda	Centre Cashier
6	Joel Muithui	Finpronet & Financial reporting

Revenue collection platform of MPESA was successfully initiated and enhanced the cashless system for receiving and banking of sales proceeds. With the support of the electronic platform, revenues increased from Ksh 5,269,213.50 to Ksh 11,593,780.00

The Centre also received Ksh 25,873,700 in form of Appropriation In Aid (AIA) from revenue sources and various funding support from GOK and donor community. This included, Recurrent GoK, AIA, KAPAP, ICARDA and ASAL APRP.

Table 2: Main Centre details on donor funding and GoK in the year 2015/2016 were as presented below;

Income /Expenditure

2015-2016

Revenue	11,593,780
Revenue from non-exchange transactions	
	Gok standing Imprest 910,000
KAPAP 1,398,880	ASAL APRP 11,043,113
ICARDA 1,546,950	Strategic Plan 500,000
Special Imprest 59,428	Haybarn Construction 200,000
AIA 10,215,329	Total 25,873,700
<u>Expenses</u>	Staff costs 18,111,590
Repairs and Maintenance 7,762,110	Total 25,873,700

6.0 PERSONNEL AND ADMINISTRATION**HUMAN RESOURCE AND ADMISRATION REPORT***By A M Odanga***Staff Establishment**

S/No.	Cadre/Specialization	No in Posts
1	Institute Director	1
2	Centre Director	1
3	Research Scientits	10
4	Technical Officer	0
5	Lab Technologist	1
6	Lab Tech.	2
7	Senior Technical Assistants	6
8	Drivers	5
9	Mechanic	1
10	Admin Support	18
11	Auxiliary	18
12	Vocational Employees	2
TOTAL		65

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

No.	Course Title	Number
1	Doctorate	2
	TOTAL	2

Staff who completed long term training during the year

Nil

Staff who joined long term training during the year

No.	Course Title	Number
1	Doctorate	1
2	MSc/MA	1
	TOTAL	2

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

No.	Training	Staff trained
1	ERP Training (Microsoft Dynamics –AX) training at HRI – Kandara Thika from 12 th October to 15 th October 2015	1
2	ERP Training (Microsoft Dynamics –AX) training at HRI – Kandara Thika from 12 th October to 15 th October 2015	1
3	Microsoft Dynamics AX-2013 Training for Accountants at the Horticultural Research Institute – Kanadara Thika from 21 st to 24 th October 2015	1
4	Attended ASAL APRP financial management at KALRO Kandara from 25 th to 27 th July 2015	4
5	Proposal writing from 2 nd to 6 th March 2015 at KALRO Njoro which was organized by KAPAP.	2
6	25 th April to 6 th May 2016 attended Land mapping for Agricultural change assessment by Regional Centre for mapping of Resources for Development at Kasarani.	1
	TOTAL	10

No.	Training/workshops/seminars	Staff trained/attended
1	ASAL APRP Annual planning and reporting workshop from 6 th – 10 th June 2016	
2	ISO Sensitization meeting at KALRO Kiboko on 24 th June 2016	
3	Pathways Lenya Conference attended by Dr. Muthiani from 10 th to 13 th Jan 2016. Held at Fairmont Mount Kenya Safari Club – Nanyuki.	
4	Student visits – <ul style="list-style-type: none"> • Kenya University College • Meru University • Karatina 	

	<ul style="list-style-type: none"> • Baraka Agricultural College – Molo • University of Nairobi. • Maseno University • SEKU
5	ICARDA Project Seminar
6	Socio-economics workshop at Katumani on 21 to 22 nd September 2015
7	Animal Production Society of Kenya Conference from 21 st to 23 rd in Mombasa.
8	XXIII International Grassland conference in India
9	National Science, Technology and Innovation week held on 11 th to 15 th May 2015
10	EAAP end of project conference.

KALRO Kiboko training of farmers

No.	Training	No of farmers trained
1	Dairy Farmers from Oletoktok – Kajiado at Githunguri which is organized by APRP from 24 th to 27 th Sept 2015.	

Transfer in

No.	Name	Date Reported
1	Andrew Apondi	Reported on 3 rd March 2015.
2	Mr. Samuel N. Sinkeet	Reported on 11 th May 2015.
3	Dr. Simon G. Kuria	Reported on 4 th May 2015
4	John Kangethe	Reported on 16 th November 2015
5	Felix Macharia	Reported on 7 th January 2016
6	Phillip N. Njuguna	Reported on 4 th May 2016
7	H.A. Suleiman	Reported on 18 th May 2016

Seven (7) staff were transferred in.

Transfers out

No.	Name	Date Reported
1	Johnson Urikae Ole Karanja	Reported 3 rd March 2015
2	Eliud Koskei	Reported on 4 th June 2015
3	Onesmus Makau	Reported in 2015
4	A.M. Odanga	Reported on 28 th April 2016

Four (4) staff were transferred out of the centre during the period January 2015 to June 2016

6.2 IMPORTANT NON-CORE ACTIVITIES

The KARI Kiboko Welfare Association (KAKISWA)

KAKISWA performed commendably well during the year. The association provided financial support to staff members by advancing loans at a reasonable interest rate thus improving their living standards. A farewell party was conducted at the Centre's Club House. During this event, members were urged to be active. Also members were advised to engage in income generating activities to aid them once they retire.

KARI Mwailu School

The institute continued to host and support the Boarding/Day Primary School by way of sitting in the board of management, supplying the school with water, milk and fuel wood for use in cooking for the pupils. The school performed well in the 2015 KCPE attaining a mean score of 353.66 marks (Table 1).

Table 1: KARI Mwailu Primary School student's performance Analysis in 2015 KCPE

No.	Marks out of 500	No of students
1	400	14
2	350-399	78
3	300-345	90
4	250-299	47
5	Below 250	5

Water

Water for staff consumption in Kiboko Centre remained a challenge due to high salinity of available water from Kiboko springs. As part of the management effort to improve the internal clients' satisfaction, drinking water was provided to staff in the office. In addition, staff were facilitated to visit the market to buy food stuffs as the Centre is situated 6 km from the Mombasa highway where the market is located.

Visitors

The Kiboko Centre was visited by over 400 people including senior officers from KALRO headquarters but most importantly, groups of farmers, NGOs, CBOs, students from different Universities and colleges and secondary schools to learn about the agricultural technologies generated by the institute.

Centre Choir

The Centre choir stopped training due to lack of a choirmaster. However there is still to engage choir master for the purpose

Health Facility

The Centre Dispensary was re-opened in August, 2011. The dispensary remained operational until May 2013. The facility was closed unprocedurally without even involving the Centre management. The Centre is still following up the issue with the county Health Department to ensure the facility is open.

Market access

The Centre has a minibus to ferry staff to Makindu and Kiboko markets. This assists staff to access fresh groceries and other social amenities with ease.

7.0 LIBRARY SERVICES

Ruth Mwangi and Odanga A

The Centre Library at the centre is equipped with reading materials. The materials include Annual reports, textbooks, periodicals, thesis reports, magazines, journals among others. Acquisition of journals via subscription was not undertaken during the year.

Deliberate effort was made during the year to catalogue the books. Also proper arrangements should be put in place to ensure that the library is equipped with current Journals and publications. The facility also was used by students on attachment and visitors to gather for the information on different areas of their interests.

The library offered photocopying and printing services to scientist and other members of staff.

The Centre management acknowledges well-wishers greatly and requests them to continue supporting the library with the reading materials.

8.0 SUPPLIES AND STORES

By James Nyaga Kinyua / Joseph M. Mbindyo, and Brettar kalekye Mwakavi

8.1 Introduction

The Supplies section is charged with the responsibility of all procurements, storage and issues of requirements (goods and services) when requested by user sections. The section was manned by one Supplies Officer who later went on early retirement on May 2015 one Senior Clerical Officer, one clerical officer and one Auxiliary Supervisor who was later redeployed in Laboratory and a new one redeployed to store in the year 2015

8.2 Review of activities undertaken during the year.

Fourty seven sets of quotations were floated with orders for supply being awarded thereafter for supply of various goods and rendering of services. In all of the orders given, a Centre Procurement Committee awarded the contracts.

8.3 Purchases/ services

During the year under review various goods/services were acquired as follows:-

8.3.1 Spare parts/ and service of vehicles

Spare parts and service for motor vehicles totalling Kshs 455,287.00 were procured for the Centre vehicles.

8.3.2 Hardware/maintenance

A total of Kshs 1,339,398.00 was spent on procurement of hardware and materials for maintenance for the Centre.

8.3.3 Drugs/Chemicals/Feed supplements'

The total purchases of veterinary drugs/ chemicals for livestock was Kshs. 1,070,917.00

8.3.4 Fuel and lubricants

A total of Kshs. 351,182.00 was spent on procurement of fuel/lubricants.

8.3.5 Stationery and Computer accessories

Kshs. 128,093.00 was spent on purchase of stationery.

8.3.6 Foodstuff for luncheons, visitors and staff meetings

A total of Kshs. 525,300.00 was spent for the above activities in the year.

8.3.7 Services

Payment for various services carried out on vehicles, machines and electrical wiring worth Kshs 362,200.00 were made.

8.3.8 Fertilizers

Kshs. 22,240.00 was spent on purchase of fertilizer

9.0 LABORATORIES

By Peter Mweki: Senior Laboratory Technologist.

Abstract

The mandate of the laboratories section to provide Technical Research Support Services to research scientists and activities at the centre continued to be upheld throughout the year, 2015. The section also offered technical training services to students from various tertiary institutions on their Industrial field training attachments.

Technical research support services.

Different sample materials generated by various research projects were presented to the laboratories for testing, qualitative and quantitative determinations and diagnosis to provide technical scientific data to augment field scientific research activities undertaken by the centre research scientists. These samples were of forage, forage seed and blood as in the table below.

Code	Type of sample	Quantity	Type of analysis.
1	Forage	615	Dry matter.
2	Forage seed	98	Viability tests
3	Blood	11	Diagnosis
Total		724	

Technical training services.

Students from various institutions of higher learning were trained in technical laboratory techniques during their technical field training attachments as tabulated below:

Code	Student Name	Institution	Course	Duration of Field Attachment.
1	(1) Student: Ms. Lucy Sinkiyian	Masai Training Institute		13 th -14 th April, 2015
2	(9) Students: Misses: Ann M. Wanjiru, Catherine Atieno, Sarah Muthee, Lydia Moraa, and Messrs: Onyango Isaac, Makate John, Mark M. Mutuku, Davis Wafula and Cedric Munguti.	South Eastern Kenya University(SEKU)	Bsc. Range Management, .Dry land Animal Science and Agriculture	11 th -15 th June, 2015
3	(21) Students.	A.H.I.T.I-Kabete	Certificate in Animal Health and Range Management	2 nd September, 2015

As in tandem with the previous year, 2014, the section continued to offer Technical Research Support Services and Technical Training Services as the two main laboratory activities in the year 2015. However the section still continued to operate at a technically minimal level due to inadequate laboratory equipment.

Once more it was hoped that with adequate laboratory equipment the laboratory activities would greatly be enhanced as well as the capacity, efficiency and quality of technical services offered in the laboratories.

10.0 TRANSPORT AND ESTATE MANAGEMENT

Odanga A. M

10.1 Introduction

The section handled a number of issues during the year under review as here-below itemized and whose details are given thereafter:

- 1) Transport
- 2) Water
- 3) Security

10.2 Transport

During the year the Centre had 9 vehicles, 1 Tractor and 4 cycles motor out of which 3 were operational. It is worth noting that the cost of maintaining this vehicles is high this can be attributed to their age because of the years they have served upon procurement and mileage. To deal with this problem it is important to have a policy in place to deal with motor vehicle disposal based on their years of service or mileage whichever comes early. This will go a long way in saving cost of maintenance and enhance efficiency in research and coordination of Centre activities.

Table 10. 1: List of motorcycles, tractor and vehicles at the Centre

REG. No.	Type	Remarks
KAN 910U	L/Rover 110 Dit TD1	Mobile
KAN 911U	L/Rover 110 Dit TD5	Mobile
KAL 638U	L/Rover 110 Dit TD5	Grounded
KBQ 285D	N/Double Cabin	Mobile
KAJ 750S	Suzuki Grand Vitara	Grounded
KBQ 532	Tractor (New Holland	Mobile
KAN 418U	Mistubishi P/up	Grounded
KAD 289M	Suzuki Vitara	Grounded
KAN 339U	Yamaha (Motor cycle)	Mobile
KAN 350U	Yamaha	Grounded
KAJ 259S	Yamaha	Grounded
KAJ 721C	Honda	Grounded
KBW 016	Toyota Land Cruiser	Mobile

Estate Management

Most of the institutional houses are in deplorable state, the institute initiated Programme in place for repairing the houses in phases junior staff houses were given priority and most of them have been repaired. This arrangement stopped. This problem cuts across the board where the Kiboko water line pipes are old and often break down. This leads to waste of Man-hours in terms of repairing the system. There is need to replace entire system with new pvc pipes which are durable.

It is important to note that despite the financial challenges, we were able to replace some of the broken pipes.

Most of the vehicles are old and the cost of maintenance is high hence the need to replace them with new ones. This will go a long way in reducing the cost of maintenance and fuel consumption.

Water

Water remains a major challenge for human consumption because of the high salinity levels. Notwithstanding the piping system is old and breaks down regularly.

The cost of repair is expensive. There is need for a total overhaul so as to reduce the cost of repair.

Security

During the year, the contracted security company delivered its services to the expectations of the Centre management. No theft cases were reported. The Ranch was invaded by illegal grazers from various parts of the country majorly camel and cattle herders, posing a major challenge to the health of livestock due to feed scarcity and diseases.