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|---|---|----------------------------|-----------------------------|
| <b>Project Title:</b>   | <b>Development of Bio-fortified Encroacher Bush species-based supplementary feed packages as Climate-change Risk-Management Strategy in Rangeland Feedlot Systems</b> |                            |                             |
| <b>Annual Report</b>  | <b>Period Covered:</b> Oct 2020 to Sept 2021 (1 year)   |                            |                             |
| <b>KCSAP livestock Applied</b>  | <b>Value chain:</b> Pastures and Fodders  | <b>Duration:</b> 18 Months | <b>Start Date:</b> Oct 2020 |
| <b>Lead Institution:</b>  | <b>KALRO (Sheep, Goat &amp; camels Research Institute (SG&amp;CRI), Buchuma Research Centre</b>   |                            |                             |
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| <b>Collaborators and their contacts:</b><br>1. Mr. Joseph Mwangi (KALRO Buchuma)<br>2. Mr. Johnstone Ruto (KALRO Buchuma)   |   |                            |                             |
| <b>Background:</b> Over 13 million pastoralists and Agro-pastoralists living in the arid and semi-arid lands (ASALs) of Kenya rely on livestock as their main source of livelihood (Ochieng <i>et al</i> , 2017). Climate change has resulted in floods and frequent droughts with subsequent unpredictable feed quantities and quality, a factor that has led to huge livestock mortalities in rangelands (GoK, 2018). Climate change impacts have also led to low productivity of animals in Kenya mainly due to inadequate feeds occasioned by fluctuations in quality and quantity of animal feed supply throughout the year (ILRI, 2015). Feed quality and quantity are functionally linked to the pulsations in the water cycle (seasonality of water availability).  |   |                            |                             |
| Direct effects of climate change on livestock productivity are evidenced in the decline in livestock productivity, low productive potential of local breeds, decline in forage resources, seasonal feed scarcity, decline in feed quality, declining grazing areas, problem of access to water and conflicts over use of limited natural resources (Ochieng <i>et al.</i> , 2017). The study by Kibria <i>et al.</i> (2017) indicated that pastoral communities living in arid and semi-arid lands (ASALs) are highly dependent on natural resources, which are sensitive to changes in climatic conditions for their livelihoods. This makes pastoralists more vulnerable to climate change and variability. Promoting the value addition and efficiency in utilization of the aggressive/invasive drought tolerant plants species would offer a solution to pastoral communities in rangelands to combat these negative effects of climate change in livestock farming systems. |   |                            |                             |

There is an urgent need to look for other feed innovations for sustainable feedlot systems in the rangelands. Value-added encroacher bush species-based Nutri-cakes are such alternatives. Encroacher bush species that are common in rangelands includes *Grewia spp.*, *Balanites aegyptica*, *Prosopis juliflora*, *Cactus (Opuntia ficus indica)*, *Acacia spp.* among others. Up-grading of these species biomass into quality animal feeds formed the basis for this study.

### Objectives

1. To develop supplementary feed resources based on value-added encroacher bush species for the feedlot systems in Kenya's Rangelands.

### Expected Outputs

1. Enhanced supplementary feed resource pool for feedlot systems in ASALs available as strategy to combat global climate change negative impacts and disasters

## ANNUAL REPORT

### I ACHIEVEMENTS

1. **Objective 1:** To develop supplementary feed resources based on value-added encroacher bush species for the feedlot systems in Kenya's Rangelands.

#### ***Activity 1.1. Identification and forage sampling of most preferred encroacher bush species by small ruminants***

##### **Achievement 1.1: (Briefly give the achievements against what was planned)**

This activity was carried on 11/11/2020. The team was able to collect samples of different bush species and also learnt on how browser forage species were grazed selectively by the browsers. Local naming of species was done to enable the team to understand the tree species for evaluation as alternative feed supplements for disaster risk management strategy in Kenya's rangelands.

Sampling was done in various locations to identify and sample most preferred bush encroacher by the Goats (browsers) in both Ranches and farm based in different parts of Taita Taveta County. Ranches visited were Mgeno, Lualenyi, Rukinga, Mbogani, Kishushe, Bura Dawida, Taita and Izera ranches. The wards where sampling took place were: Chala, Mata, Njoro, Eldolo, and Wundanyi, as most farmers were from Maasai and Taita communities.

##### ***Sampling procedures of most preferred forages***

Herders in various ranches and local communities were used to identify the forages preferred by browsers by local names which were then matched to scientific names. This was done by following the animals for 30 minutes once a day for five days during the short rains. Bites were recorded for each plant species grazed (see figure 1).

Based on the number of bites, the 16 most preferred forages were identified for each plant species.

A total of 53 forage samples were collected. Out of the 53 samples, 15 samples were recommended as the most preferred forage species by browsers based on their rate of bites (as indicated above).



*Figure 1: Recording of bites for each plant species by browsers*

***Activity 1.1.1: On station harvesting and conservation of value-added encroacher bush species for dry season feeding***

**Achievement 1.1.1: Construction of two bank silos for conservation of value-added invasive bush species**

Two 30-ton bunk silos were constructed in the Centre (Figure 2). The aim of constructing these bunk silos was to act as “fodder banks” to demonstrate and ensure that no livestock dies of hunger in such harsh environments. The environmental conditions around the Centre cannot support rainfed Napier grass (*Pennisetum purpureum*) production. However, effective utilization of available natural resources such as invasive bush species to sustain the livestock during drought can solve the problems of feed scarcity and loss of animals. Approximate 15 tons of encroacher bushes were treated with additives and stored for use in drought periods.



*Figure 2: Constructed bank silos for conservation of value-added invasive bush species at KALRO Buchuma*

**Activity 1.2:** Nutritional characterization of most preferred encroacher bush species by small ruminants

**Achievement 1.2:** The recommended 15 forage samples (Out of the 53 total collected samples) were analyzed for their chemical composition for proximate analysis (CP, CF, ash, EE, ME and NFE) at Dairy Research Institute, KALRO Naivasha. Results from the laboratory analysis revealed that there was variation in the nutrient composition of the most preferred and abundant forage species in the study region. The chemical composition of some of the forages was equivalent to that of planted forages, and can thus be harvested and conserved for use during calamities such as pandemics and severe droughts.

**Activity 1.3. Assessment of various methods of improving the feed value of encroacher bush species-based supplements as alternatives for feedlot systems in ASALs**

Utilization of invasive bush species is of great interest, due to environmental/climatical reasons, where livestock-based enterprises are increasingly being forced to find an alternative sources of supplementary feeds. Moreover, the use of these invasive biomass wastes considerably can reduce the cost of livestock production. Therefore, this project sought to find value addition methods that can increase the utilization of these invasive tree biomass and application in the production of value-added supplementary feed packages from products from wastes.

Various methods of treating encroacher bush species biomass (see figure 3 and 4) were evaluated in the study as listed:

1. Untreated bush feeds samples (Control)
2. EM-treated bush-feeds
3. EM + Urea treated
4. EM + NaOH
5. EM + Urea + Lime treated bush feed

6. EM + Urea + NaOH
7. Urea + NaOH + Lime treated bush feed+ EM



*Figure 3: Processing of encroacher bush species as an emergency animal feed  
Climate Change Risk Resilience: Bush-to-Feed (Shredding of bush feeds at KALRO Buchuma).*



*Figure 4: Processing of encroacher bushes for livestock feeding*  
**Summary of achievements under objective 1**

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| <b>Output 1</b>   | <b>Activities</b>  | <b>Targeted Milestones (Targeted)</b>  | <b>Actual Achievements</b>  |
|---|--|--|---|
| 1.0 Enhanced supplementary feed resource pool for feedlot systems in ASALs available amid global human health pandemics and drought disasters | <p>1.1 Identification and sampling of locally available encroacher bush species most preferred by livestock</p> <p><i>Activity 1.1.1: On station harvesting and conservation of value-added encroacher bush species for dry season feeding</i></p> | <p>1.1 At least 50 samples collected for proximate analysis by Q1Y1</p> <p>-</p>   | <p>1.1 Collection of 53 samples of most preferred forage species by browsers was completed and submitted for proximate analysis.</p> <p>Achievement 1.1.1: Construction of two bank silos for conservation of value-added invasive bush species was completed during the reporting period</p> |
|   | 1.2 Nutritional characterization of identified bush feed samples   | Lab analysis of at least 50 samples completed by Q2Y1  | Out of the 53 samples collected, 15 samples were recommended as the most preferred forage species by browsers and were analyzed for their chemical composition as per the targeted period   |
|   | 1.3 Assessment of various methods of enhancing the feed value encroacher bush species  | 1.3 Various methods of up-grading encroacher bush species biomass to quality animal feeds identified and evaluated by Q3Y1 | 1.3 At least 6 treatment methods were summarized and recommended for testing out of the 16 methods previously identified. Treated samples were taken for analysis and lab records are available (awaiting statistical analysis).  |

**II Other achievements** (e.g., patents, publication such as journal papers, technical reports, presentation in workshops and conferences etc.). List them with proper citations

**A) Two book chapter publications**

**i. Margaret Syomiti., Maranga, E and Obwoyere, G., (2021).** Study on Nutritional Characterization of Cactus (*Opuntia ficus indica*) as Forage in Kenya's Rangelands. *Cutting-edge*

**ii. Syomiti, M., Chirchir, S., Duyu, J., & Dana, H. (2021).** *Experiences of Low-external-Input Livestock Systems.* In E. S. Nadia (Ed.), *Managing Healthy Livestock Production and Consumption*. Pp. 197-201. ELSEVIER. ISBN: 978-0-12-823019-0.

## **B) Journal papers**

**Margaret Syomiti., Maranga, E and Obwoyere, G. (2021).** Study on Nutritional Characterization of Cactus (*Opuntia ficus indica*) as Forage in Kenya's Rangelands. *International Journal of Innovative Research Vol. 10 Issue 5. DOI:10.9734/bpi/cras/v11/2623F*

## **C) Conference papers**

**Margaret Syomiti, Maranga, E., Obwoyere, G., Mugo, B., Getachew, G. Dana, H., and Wamae, D. 2021.** Nutritional Characterization of Cactus (*Opuntia ficus indica*) as Forage in Drylands of Kenya. Proceedings of the Animal Production Society of Kenya held on October 13-14, 2021 at Chaka Hotel, Machakos.

**D) Brochure development:** Completed (One brochure is available)

**E) Procurement of livestock feed processing machineries supported by KCSAP fodder was achieved.**

## **III Constraints and how they were overcome**

- Chronic delays in procurement processes: Purchase of test feed ingredients, feed processing machineries was delayed for about four quarters. It is also taking too long to identify pre-qualified suppliers. Up-loading items in the STEP (world bank requirement) was also a challenge contributing to delays in project implementation. Constant pestering the SCM office was adopted, and this restlessness prompted them to act.
- Current pandemic and associated restrictions on movement hindered execution of activities that require office meetings, and meeting with farmers. Us of virtual meetings and mobile phone calls for discussion of crucial matters was adopted to combat the problem.

## **IV Summary of funds received, accounted for and balance**

| <b>Project Amount (KES)</b>                | <b>Amount Received (KES)</b> | <b>Amount accounted for (KES)</b> | <b>Balance (KES)</b> |
|--|------------------------------|-----------------------------------|----------------------|
| 1 <sup>st</sup> ALLOCATION<br>KCSAP FODDER | 1,728,320.00                 | 1,523,430.00                      | 1,680                |
| 2 <sup>nd</sup> ALLOCATION<br>KCSAP FODDER | 913,990.00                   | -                                 | Nil                  |

## IV Way Forward

Activities Planned for the Period Oct 2021-June 2022

| MILESTONE FOR NEXT QUARTERS: PENDING ACTIVITIES   |  |  |                                |
|---|--|--|--------------------------------|
| Output 2  | Activities   | Targeted Milestones (Targeted)   | Targeted Milestones (Targeted) |
| 2.0 A low-cost finisher rations based on value-added encroacher bush species as animal feed available to livestock feedlot producers in ranches | 2.1 On-station feeding trials  | 2.1 On-station data collection on feedlot livestock performance based on bio-processed encroacher bush species completed by Q4Y1 | PENDING                        |
| Output 3  | Activities   | Targeted Milestones (Targeted)   | Actual Achievements            |
| 3.0 Profitability/Cost-benefit analysis of fortified bush feed innovations determined by quarter 5 and 6 and the best-bet recommended           | 3.1 Cost-benefit analysis of the up-graded encroacher bush feed for feedlot system | 3.1 One consultative meeting/participatory partial budgeting workshop with stakeholders held by end of Q2Y2                      | PENDING                        |

## Cited Literature

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**Opiyo, F.; Wasonga, O.; Nyangito, M.; Schilling, J.; Munang, R., 2015.** Drought adaptation and coping strategies among the Turkana pastoralists of Northern Kenya. *International Journal of Disaster Risk Science and Management*. 6; 295-309.