Regenerative fodder production: Balancing ecology and livestock needs in Kisumu and Vihiga counties.

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Introduction

Fodder grasses and legumes are essential components of sustainable livestock farming. They provide high-quality nutrition for animals, improve soil fertility, and contribute to sustainable agricultural practices for livelihoods and the environment. In Nature positive conservation we focus on environmental conservation, including protecting species from extinction, maintaining and restoring habitats, and enhancing ecosystem services. Notenbaert et al. (2021). Therefore, integrating improved forages into mixed crop-tree-livestock systems is associated with a wide variety of practice changes. These changes include agronomic and animal husbandry practice change, awareness creation, capacity building, and multi-stakeholder engagement approaches to actions associated with the broader food systems, such as waste reductions and dietary shifts.

We established two demonstration plots, one in Vihiga and one in Nyando-Kisumu County, the main objective being to conduct on farm-training with farmers from land preparation to harvesting and feed conservation. The fodder trees planted include *Calliandra*, *Leucaena* and *Sesbania sesban*. The grasses include *Brachiaria* hybrids (B. Mulato II, Cobra Cayman and Camello). *Brachiaria* cultivars (*B. Xareas* and Basilisk) and *Panicum* Mombasa. Legumes planted include *Crotalaria*, *Lablab* and *Desmodium*.

Site Selection and Soil Preparation

We chose well-drained, fertile soils with adequate sunlight, thereby considering the climatic conditions suited to specific fodder species. We ensured the area was free from heavy weeds and pests. We conducted 1st and 2nd ploughing to break up the soil and allow deep root penetration, then we used the jembe to create a fine tilth by breaking up bigger clots.

Land preparation is done in Jimo east (Kisumu County).

Fodder trees

Fodder trees are an essential component in sustainable livestock farming. Farmers cultivate them primarily to provide feed (leaves, fruits, pods, bark) for livestock. We have also integrated them into agroforestry systems. They provide high-quality, protein-rich feed, sustain livestock during dry seasons, improve soil fertility through nitrogen fixation (for certain species), offer shade and shelter for animals. We planted three distinct species: (i) *Leucaena leucocephala*, which has high protein content, and is drought-resistant and nitrogen-fixing; (ii) *Sesbania sesban*: Quick growing, thrives in a range of soils, good for intercropping and (iii) *Calliandra*. We planted a total of three hundred trees in Jimo east.

Before planting trees, it is recommended to raise the seedlings in a nursery, we established a tree nursery in Nyakach (Agoro East) where we maintained them for a period of 2 months then potted and left them to acclimatize for one month before transplanting to the field. Trees can also be propagated through cuttings e.g., the mulberry. Management includes regular pruning and weeding; most farmers feed the leaves to the livestock. During feeding farmers mix the harvested fodder trees with grasses as they feed them to the livestock. Harvesting fodder is typically in a "cut-and-carry" system, where leaves and small branches are pruned regularly, for more foliage growth and maintains tree height for easy harvesting. Fodder trees also have other benefits including:

- Soil improvement: fodder trees, like Leucaena, fix nitrogen in the soil, improving fertility.
- Erosion Control: Deep-rooted trees help prevent soil erosion.
- Biodiversity: Fodder trees can support wildlife and contribute to ecosystem diversity.
- Carbon Sequestration: Trees fix CO_2, contributing to climate change mitigation efforts.

Fodder trees established in Jimo- East Nyakach (Kisumu County): pruning on-going.

Grasses and legumes

Seed Selection

We use certified seeds of improved varieties to ensure high germination rates and disease resistance. We sourced our seeds from Advantage Crops Limited and Kenya Agricultural and Livestock Research Organization.

During planting we used drilling and placed the seeds. In drilling, seeds planted in rows using a seed drill, allowing for uniform depth, and spacing which is usually 45cm by drill for *Panicum* and 45cm by 15cm for all *Brachiaria* in hole placement.

If you are planning to establish a nursery, it is better to prepare one before the onset of rain, then transplant after 45 days spacing at 50cm by 30cm. Transplanting should coincide with the onset of the rainy season for optimal growth.

Crop Management

We controlled weeds manually by hand weeding using hoes. Weeding helps minimize competition for nutrients and sunlight with fodder crops. After two months we top-dressed using well decomposed organic manure. After 3 months (90 days) from planting, the grass was ready for first harvesting. Harvesting is done just before flowering when protein content is optimal. For legumes, harvest at the early flowering stage to ensure optimal protein and digestibility. For the legume varieties planted we left them to produce seeds and harvest to ensure enough seeds for the next season. Harvesting was manual, i.e., cutting the fodder using sickles as in the photo below. However, in large farms one can use harvesting machines.

Post-Harvest Handling

After harvesting, we dried the grasses and the legume seeds that we had harvested by spreading the harvested grass and seeds in the sun for three days during dry period to reduce the moisture content to about 13%. Another method of forage preservation is through silage; this process involves chopping the fodder into small pieces and storing it in airtight conditions to ferment. Hay making is one of the most common methods used by small scale farmers since it requires less skills and less capital. Primarily, fodder conservation serves to preserve excess forage during rainy season for use during the dry season when forage is scarce. We recommend store hay in a cool, dry place, preferably in well-ventilated sheds to prevent mold and spoilage.

Hay Produce

From the plot size of 350mSq the group got 10 hay bales each weighing between 13kg -15kg, often weights on the market in Kenya. During the first harvest, usually not the optimal yield is obtained, but on subsequent 1st and 2nd ratoon the harvest yield increases as more tillers develop adding to the biomass but requires maintaining soil fertility.

Drying the grass to reduce moisture content before bailing


Harvesting of fodder grasses in Vihiga county with Liana ginga farmers group members


Harvesting of legume (crotalaria) in Kisumu County Jimo East members

Crotalaria seeds

Cost Benefit Analysis

A Cost Benefit Analysis with farmers comparing the yield of grass to maize which they estimated to be 40kg from an area of 350m^2 on the highest. We estimated the price of bales at Kes 400 per bale and compared with 40 kg of maize from the same area of 350m^2 and a kilo of maize estimated at Kes 70. Break down the estimation is as follows:

We take yield of hay bales versus maize from the 350m^2 plot. We account for total costs against the expected benefits (revenue/yield) for either hay or maize.

- Price per hay bale: Kes 400
- Number of bales per harvest: 10
- Number of harvests per year: 5 (five cuttings in a year)

Total income from hay bales = 10 × 400 x 5 = Kes 20,000

Costs

- Grass seeds: Kes 2,000
- Manure: Kes 2,000
- Top dressing for the next 4 harvests: Kes 4,000
- Labor: we assumed all are provided by family in both Forage and maize.

Total expenses: 2,000 + 2,000+ 4,000= Kes 8,000

Potential Profit in a year: 20,000 - 8,000 = Kes 12,000

Maize option:

- Price per kg of maize grain: Kes100
- Number of kilos per harvest: 40
- Number of harvests per year: 2
- Income from maize: 40 × 100 x 2 = Kes 8,000

Cost

- Maize seeds: Kes 600
- Manure: Kes 1,000
- Top dressing: Kes 1,000.
- Costs for season II (same as first season): 2,600
- Labor: we assumed both are provided by family for free.

Yearly expenses: Kes 5,200

Potential Profit in a year: 16,000 - 5,200 = 10,800

Forage seed bank

Vihiga and Kisumu County have a community seed banks with native seeds of vegetables, legumes, and grain seeds for human consumption. We managed to secure a shelf and stock some of the fodder seeds for legumes, grasses, and trees. There are many reasons to store seeds. One is to preserve the genes that plant breeders need to increase yield, disease resistance, drought tolerance, nutritional quality, taste, etc. of crops. Another is to forestall loss of genetic diversity in rare or imperiled plant species in an effort to conserve biodiversity ex situ. Many plants that were used centuries ago by humans are used less frequently now; seed banks offer a way to preserve that historical and cultural value. For most fodder grasses like hybrids and cultivars we stock them in seedbank as a learning resource and to educate farmers more about livestock feeds, for legumes and fodder trees, the seed back community system allows farmers to borrow seeds for planting and return in double amount "a system of butter trade".

Fodder seeds on display at one of the farmers exhibitions held in Vihiga County

Members of Liana ginga biodiversity nature positive with their ready bales of hay

Conclusion

Fodder grasses and legumes play a vital role in sustainable livestock production. Successful cultivation requires careful attention to site selection, soil preparation, planting, crop management, and harvesting. By following better practices, farmers can ensure a consistent supply of high-quality fodder, contributing to the health and productivity of their livestock.

From the cost benefit analysis, we have also realized that an acre of fodder is more profitable than an acre of maize in Liana ginga Bioversity group. We therefore encourage farmers to venture into more profitable agribusiness like fodder cultivation.

References

Tapping Into the Environmental Co-benefits of Improved Tropical Forages for an Agroecological Transformation of Livestock Production Systems. Frontiers in Sustainable Food Systems 5, 434. doi: https://doi.org/10.3389/fsufs.2021.742842

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