Feeding spineless cactus to cattle for drought resilience, Kenya

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Description: Challenges facing pastoral farming systems in Kenya

Livestock is an important livelihood resource in the pastoral farming systems of Kenya. Pastoral communities largely depend on the persistence of low-input livestock systems in the country. However, climate change, natural disasters and desertification threaten these livelihood resources, particularly in dry areas (GHF, 2009). Water scarcity, poor quality soils and inadequate supply of quality feed are the major constraints of livestock grazing in the arid and semi-arid regions of Kenya.

The pastoral farmers in dry lands have used migration in search of water and feeds as a coping strategy when faced with droughts. In many cases, this has caused ethnic clashes over limited feed and water resources. Overgrazing of communal land resources has also been a problem, with subsequent loss of livestock.

In addition to providing meat and milk for the smallholder farming families, livestock farming has also been a traditional means of earning income. However, livestock production in this region is constrained by poor feed resources resulting from the low productivity of pastures. Animals depend on natural pastures, primarily grasses and tree shrubs. During the dry season there is normally a feed deficit, forcing farmers to move animals to other areas to avoid loss of their animals due to recurrent droughts. The problem is exacerbated by climate change. This study presents an alternative source for feeding livestock in periods of drought, making it possible to adapt low-input production to climate change and contribute to ongoing sustainability.

Spineless cactus as an alternative feed for drought resilience

Pastoral farmer Samuel Chirchir has an 8.9 ha farm with 50 cattle, 25 goats and 10 sheep, which has been in operation for 20 years.Faced with the threat of drought, Mr Chirchir applied practices informed by indigenous traditional knowledge (ITK) combined with scientific research, planting spineless cactus (*Opuntia ficus-indica*) as an alternative drought-resilient feed resource. Using spineless cactus, Mr Chirchir has been able to sustain cattle production throughout recurrent droughts, which could have forced him into conditions of chronic poverty.

Cacti are characterized by high water use efficiency (WUE). Their pads (cladodes) are covered with thick epidermis and stomata which are closed during the day but open at night. This has the effect of reducing water evaporation in this plant species. Cacti are desert plants that can survive where nothing else can grow. This makes them a suitable plant resource for climate change adaptation. Cacti are multipurpose range species. They could be used to provide forage for livestock, food for humans, and as a tool to combat desertification. Pads of cacti are high in soluble carbohydrates, calcium, potassium and vitamin A, but are low in fibre and crude protein (CP 4-5 percent percent). Cacti are also considered as a source of water for animals raised in harsh environments (Nefzaoui and Ben Salem, 2001). Supplementing poor roughages (such as straw) with cactus, increases straw intake and forage digestibility and improves microbial activity, but decreases cellulolytic activity (Ben Salem *et al*. 1996).

Ben Salem *et al*. (2002) showed that protein nitrogen supply improved the nutritive value of cactus-based diets fed to lambs and increased daily body weight gain. There was a further improvement when the level of by-pass proteins in the diet was increased. It is notable that cactus pads may reduce the use of concentrate feed and therefore the feeding cost. As a result, using spineless cactus for cow fattening allowed Mr Chirchir to sell the meat at higher prices later.

Growing spineless cactus to cope with droughts

Mr Chirchir had eight animals and used spineless cactus to feed them from January to April 1994. All the animals survived. In contrast, neighbours' animals did not survive the drought. In 1995, Mr Chirchir decided to plant 2,450 individual plants of spineless cactus on 2.23 ha of land. The plants were collected and domesticated on his homestead.

In 2000, during another severe drought alternative coping strategies were tested. The herd was separated, with 26 cows taken to the distant district of Loboi and 16 cows staying to feed on cactus. Of the cows that migrated, only 6 survived, while all the 16 cows left in the homestead to feed on the cactus survived, and looked healthy.

In 2004, Mr Chirchir was supported by Asal-based Livestock for Livelihoods Improvement Project for Rural Development (ALLPRO), with USD 5,600 to increase the area of spineless cactus from 2.23 to 4.47 ha. In 2009, all 24 cows and 9 goats survived. In 2014, cactus plants had grown from 1.8 to 3 m tall and supported about 50 cattle (42 adult animals and 8 weaned calves).

For further research activities, there is need for seed multiplication three sites in selected dry land sites such as Mr Chirchir's farm in Baringo County and two sites at the National Dry land Research station of the Kenya Agricultural and Livestock Research Organization (KALRO)- Kiboko research station (4.47 ha) and Marsabit research station (4.47 ha).

Improving feeding strategies

The spineless cactus based diet can be further improved. For example, Mr Chirchir observed loose stool from his livestock feeding on spineless cactus, which can become pathogenic. The KALRO research team advised him to combine cactus feeding with a high fibre diet to address this problem.

Another challenge is that spineless cactus alone does not provide a sufficient diet for animals, due to limited Crude protein of approximately 5%. It is necessary to combine other options, e.g. alley-cropping with other drought-resilient plant species such as saltbush (*Atriplex* species), incorporation of crop residues (if available), wilting prior to feeding of spineless cactus to livestock and other feed processing technologies.

Atriplex species have been reported to sustain livestock in the West Asia and North Africa (WANA) region (Ben Salem *et al*., 2010). However, it is not known if this is possible in Kenya (Syomiti, unpublished data). The scarce plant materials available in the Chelbi desert (Marsabit County) and at Tana River are disappearing. The rich genetic diversity of *Atriplex* species has been conserved at the National Genebank of Kenya. However, these seeds that are stored in shelves are not available to farmers.

There is a strong need to conserve *Atriplex* and spineless cactus species before they become extinct. On-farm conservation and the popularisation of the benefits to the end users (pastoral farmers) will be important steps. So far, the genetic diversity of spineless cactus species has not been conserved using appropriate technologies.

Further research on the optimum wilting time of spineless cactus (for instance 0, 6, 12, 24, 48, 60, 72, 96 or 120 hours) is also required for maximum nutrient retention (as nutrients are lost if the wilting time is too long).

The most limiting nutrient in the diet of livestock on rangelands is protein. Because of its limited supply, protein should be used more efficiently to promote efficient fermentation of roughage in the rumen for improved animal performance.

Formulation of Cactus-Atriplex species based total mixed rations can be a potential intervention.

Cactus cladodes/pads are high in soluble carbohydrates, allowing animals to make better use of the high amount of soluble nitrogen in *Atriplex* foliage. Abundant water in cactus pads can also facilitate excretion of the excessive salt in *Atriplex* foliage. *Atriplex* species can overcome the nitrogen and fibre deficiency in cactus pads. The formulation of spineless cactus-based Total Mixed Rations (TMR) was designed using the computer software Feedsoft and “SOLVER” function.

It is important to note that although concentrates are not readily available or affordable for resource-poor pastoral farmers in dry regions, there are other non-conventional feed resources that are locally available. In arid and semi-arid areas, these include *Prosopis*

species pods, *Acacia* species (mainly *A. tortilis*) and *Balanite aegyptica*. All these can serve the same purpose as expensive concentrates. The twigs, leaves, shoots, pods and fruits of *B. aegyptica* can be harvested with clips for incorporation in the TMR.

Other challenges and opportunities in promoting spineless cactus feeding

Using spineless cactus as livestock feed can improve production of meat and milk for cash earnings, helping to reduce poverty and improve livelihoods. A higher market price can be achieved if animals are fattened. In 2009, Mr Chirchir was selling cattle at 200 USD and goats at 17-28 USD, compared to neighbours who were receiving 28 USD for cattle and 3-8 USD for goats.

On-farm training of farmers in using spineless cactus seed production, management and utilization as feed is a viable option to enhance livestock sustainability in the drylands. Further opportunities in improving sustainability of cactus feeding strategies include:

- Establishment of more sites for seed multiplication;
- Up-scaling of spineless cactus production to other dryland ecosystems in Kenya;
- Conservation of spineless cactus diversity;
- Spineless cactus feed conservation as hay and silage;
- Establishing a cut-and-carry feeding system (to avoid wastage and tramping from grazing).

Lessons learnt

Spineless cactus is an under-utilized feed resource in this region. The following lessons can be learned from the experiences of Mr Chirchir and research partners working on spineless cactus feed:

- As a drought resilient feed resource, spineless cactus has proved to sustain livestock, especially in the wake of frequent droughts and floods. Resilience to extreme weather events will become more important as the effects of climate change exacerbate natural disasters;
- Farmers should avoid *in-situ* grazing on cactus fields, so as not only to avoid trampling and wastage of the cactus feed, but also to avoid overfeeding of this feed for reduced diarrhoea incidences;
- Feeding cactus in combination with other high fibre feeds such as crop residues can help to optimize diets along with plants with moderate to high protein content;
- The formulation of optimum cactus-based Total Mixed Rations (TMR) is important;
- Conservation of cactus species is vital, in order to increase use in feeding strategies.

Forming partnerships with research institutions is an important step to improve the knowledge and practice of spineless cactus feeding technologies. There are opportunities for collaboration between research partners and farmers to conserve spineless cactus species at different sites, both in research stations and farmers' fields. Spineless cactus feeding strategies have been developed through farmer innovation and experimentation. There are further opportunities to improve methods through farmer-researcher collaboration.

Many farmers have now witnessed how spineless cactus can prevent livestock deaths during periods of drought. Training and demonstrations at field days could raise awareness in other arid and semi-arid regions in Kenya for farmers to improve the sustainability of their livestock feeding strategies. Workshops are an opportunity to discuss the added value of technologies such as the manufacturing and utilization of cactus-based multi-nutrient feed blocks.

References

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