Evaluating climate-change adaptability and cattle-preference of forage plants in Marsabit central district, northern Kenya

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Research Brief

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Abstract

Northern Kenya is an arid or semi-arid area where pastoral livestock production is the most viable livelihood option. However, livestock production faces challenges with forage scarcity due to increased climate variability. Government and non-governmental organizations are striving to promote forage farming and in-situ forage conservation in an effort to arrest forage scarcity. This effort requires understanding of the climate-adaptability and nutrient content of forage plants preferred by livestock. Through focus group discussion, feeding observations, and nutrient analysis, the study revealed adaptability, nutrient content and preference of common forage species utilized by cattle in the Marsabit central district. We found that cattle forages species such as Tinospora caffra *root tuber, Sorghum* verticiliflorum steud *and* Cenchrus ciliaris L. *are cattle-preferred, have high nutrient content, and are adaptable to climate variability. Therefore, these species need to be targeted for farming and conservation efforts to address feed scarcity.*

Climate variability has negative impacts on forage production

Climate variability is a major concern for world's rangelands due to its negative impacts on forage production. Research has shown that climate variability is likely to reduce forage production by 21% in arid and semi-arid lands of the world (Mckeon et al., 2009). This climate variation mainly manifests itself through decreased annual rainfall and increased temperatures. Livestock production in arid and semi-arid lands of Kenya has been shown to be vulnerable to these stresses posed by climate change (Opiyo et al., 2014). Climate change and variability have reduced forage plants in arid environments of northern Kenya, and negatively impacting cattle production. Important forage plants are on decline, calling for deliberate efforts to conserve endangered forage plants using in situ methods or promotion of forage farming. Knowledge of preferred forage plants, nutrient content and adaptive ability can guide farmers and development agents towards the best forage plants for farming and in situ conservation (Sanon, H.O. et al., 2005, Udeh, I. et al., 2013).

Researchers conducting transect walk to assess availability of forage plants (Photo credit: David Duba Golicha)

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Farmer Focus Groups and Field Studies Elucidate Cattle-Preferred and Adaptive Forage

Conducting Focus Group Discussion to identify cattle-preferred and adaptive forage plants. (Photo credit: David Duba Golicha)

This study was conducted in Marsabit central district, northern Kenya. Focus group discussions (FGD) were conducted in three different locations of Marsabit Central district. There were 15 pastoralist elders in each discussion group. FGD were used to identify cattle-preferred and adaptive forage plants based on pastoralist's knowledge. Adaptive forage plants are those that adapt well to climate change and drought. Feeding observations were then used to confirm forage plants preferred by grazing cattle and compared to those identified by pastoralists. Nine different species of forage plants identified by pastoralists as preferred were offered to 20 head of mature zebu cattle. The forages had similar initial weights of 20 kg. The weight of forage intake was determined after 45 minutes of feeding for each of the forage plant species. The experiment was repeated twice. The aforesaid methods resulted in identification of preferred and adaptive forage plants. Additionally, a participatory transect walk was done along a 4KM transect in the grazing field during both wet and dry seasons to determine the frequency of preferred and adaptive forage plants. Laboratory analysis of nutrient content was then conducted for the identified preferred and adaptive forage plants.

Feeding observations confirmed cattle-preference for specific forage plants

Information about forage plants that are adaptive to climate variability and preferred by cattle is needed to promote forage production and conservation in northern Kenya. In this study, pastoralists in Marsabit central district identified nine preferred forage plants for their zebu cattle and their perceived adaptive capacity to climate variability. Pastoralist-identified forage plants that were both cattle-preferred and adaptive to climate variability include the *Mela* shrub (Sorghum *verticiliflorum steud*), *Ogono* grass (*Pennisetum mezianum* lake), *Gurbi olla* shrub (*Triumfetta flavescence A. Rich*), *Rupis* tuber (*Tinospora caffra* root tuber), and *Mattgudesa* grass (*Cenchrus ciliaris L.*). Subsequent feeding observations confirmed the following five adaptive and non-adaptive forages as being highly preferred by cattle: Sorghum *verticiliflorum steud*, *Chrysopogon Aucheri Boiss*, *Bothriochloa insculpta hochst*, *Tinospora caffra* root tuber and *Cenchrus ciliaris L.* (Table 1).

Understanding nutrient content of forage plants expands knowledge on preferred and adaptive forages

Nutrient content analysis of adaptive and cattle-preferred forage plants identified key plants that could not only endure climate variations, but also provide increased nutrition to foraging cattle. Analysis for the following nutrient contents was conducted: dry matter, crude protein, nitrogen free extracts (carbohydrate, sugar, hemicellulose content, etc.), estimated metabolisable energy, and sodium and calcium levels. Identified adaptable, preferred, and highly nutritious forage plants included *Cenchrus ciliaris L.*, *Tinospora caffra* root tuber, and Sorghum *verticiliflorum steud*. These plants showed increased nutritional value in terms of crude protein, digestibility, energy, and/or nutrient content. By focusing on these adaptable, cattle-preferred, and highly nutritious

Table 1: Preferred forage plants based on feeding observations

Types of forage plants		Average forage intake over 45 minutes (kg)	Coefficient of preference[1]
Boran local name	**Scientific name**		
Gurbi Olla	*Triumfetta flavescense A. Rich*	0	0
Adha	*Aspillia mossambicensis (olio) wild*	0	0
Ogono	*Pennisetum Mezianum lake*	8	0.081
Ilmogor	*Latipes senegalensis kunth*	9	0.092
Mattgudesa	*Cenchrus ciliaris L.*	13	0.132
Dilalesa	*Bothriochloa insculpta hochst*	15	0.153
Rupis	*Tinospora caffra root tuber*	16.2	0.165
Halalo	*Chrysopogon Aucheri Boiss*	17	0.173
Mela	*Sorghum verticiliflorum steud*	20	0.204
Total forage intake for 20 heads of zebu cattle (kg)		**98.2**	

[1]Coefficient of Preference (COP) was calculated as the ratio between the intakes of each forage divided by the total intake.

Table 2: Nutrient content of cattle-preferred and adaptive forage plants

Types of forage plants		DM (%)	CP (%)	NFE (%)	EST MCAL/kg	Na (%)	Ca (%)
Boran local name	Scientific name						
Gurbi Olla	*Triumfetta flavescense A. Rich*	91.80	5.69	44.49	2.08	0.02	0.47
Adha	*Aspillia mossambicensis (olio) wild*	92.13	5.95	59.42	2.89	0.045	0.76
Ogono	*Pennisetum Mezianum lake*	93.67	3.68	38.40	1.69	0.05	0.03
Ilmogor	*Latipes senegalensis kunth*	95.33	4.86	37.09	1.79	1.57	0.022
Mattgudesa	*Cenchrus ciliaris L.*	93.52	4.72	41.64	1.90	0.035	0.03
Dilalesa	*Bothriochloa insculpta hochst*	94.29	5.87	40.88	1.83	0.045	0.07
Rupis	*Tinospora caffra root tuber*	96.57	3.62	76.02	2.30	0.02	0.16
Halalo	*Chrysopogon Aucheri Boiss*	95.65	6.38	35.15	2.39	0.035	0.05
Mela	*Sorghum verticiliflorum steud*	94.56	4.40	44.47	1.99	0.03	0.05

DM-Dry Matter, CP-Crude Protein, NFE-Nitrogen Free Extracts, EST MCAL- Estimated Metabolisable Energy, Na-Sodium, Ca-Calcium

forages, cattle productivity can be increased, while simultaneously preserving valuable pastureland amid increased climate variability.

Participatory transect walk revealed that some of cattle-preferred forage plants with better nutrient contents are very scarce in Marsabit central district

A participatory transect walk showed that some of the cattle-preferred forage plants are less available in the grazing field. For example, *Chrysopogon Aucheri Boiss* (with a frequency of 0.008 during wet season and frequency of 0.007 during dry season) and *Bothriochloa insculpta hochst* (with a frequency of 0.012 during wet season and frequency of 0.011 during dry season), though highly preferred by cattle, were lacking in grazing areas. The scarcity of these and other plants is caused by their lack of adaptive capacity to variable climatic conditions. For those highly preferred by cattle, overgrazing increases their scarcity due to their limited adaptive capacity, preventing regrowth sufficient enough to offset cattle consumption. Conversely, other plants such as *Triumfetta Flavescense A. Rich* (frequency of 0.196 and 0.296 in wet and dry seasons, respectively), and *Aspillia mossambicensis (olio) wild* (frequency of 0.262 and 0.373 in wet and dry seasons, respectively) showed higher frequencies and increased resilience during dry seasons. But, such grasses were also the least-preferred by cattle based on feeding observations, suggesting one reason for their increased frequency and limiting their use as cattle forage.

Conclusion

The study revealed that some of the highly preferred forage plants for cattle including *Chrysopogon Aucheri Boiss, Bothriochloa insculpta hochst* and *Latipes senegalensis kunth* are not adaptive to climate variability, and hence are scarce in the Marsabit central district. However, other forage plants such as *Cenchrus ciliaris L., Tinospora caffra* root tuber, and Sorghum *verticiliflorum steud* were found to be adaptive, have good nutrient content, and also be preferred by cattle, therefore, these plants are recommended for on-farm production and in-situ conservation.

Table 3: Frequency of cattle-preferred forage plants

Types of forage plants		Availability during wet season[2]	Availability during dry season[2]
Boran local name	Scientific name		
Gurbi Olla	*Triumfetta flavescense A. Rich*	0.196	0.296
Ogono	*Pennisetum Mezianum lake*	0.223	0.044
Ilmogor	*Latipes senegalensis kunth*	0.011	0.004
Mattgudesa	*Cenchrus ciliaris L.*	0.054	0.042
Dilalesa	*Bothriochloa insculpta hochst*	0.012	0.011
Rupis	*Tinospora caffra root tuber*	0.079	0.121
Halalo	*Chrysopogon Aucheri Boiss*	0.008	0.007
Mela	*Sorghum verticiliflorum steud*	0.157	0.103

[2]Frequency=ni/N, where ni is the sum of an individual plant species, and N is the total sum of all preferred forage plants.

Further Reading

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Proposals are selected based on their potential to make livestock production systems more resilient to increasing climate variability and severity. At the end of one year, TIRI scholars are expected to demonstrate concrete outcomes and real potential for future impact. The 10 selected East Africa TIRI scholars and the 18 selected Nepal TIRI scholars are addressing research problems on various livestock and climate research themes.

Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change is dedicated to catalyzing and coordinating research that improves the livelihoods of livestock producers affected by climate change by reducing vulnerability and increasing adaptive capacity.

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