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Research Application Summary

Community perception of importance, trends, and variations of indigenous grasses in Southern Kenya

Ndung'u, P. L. N.,[1] Wasonga, O.V.,[1] Mnene, W. N.,[2] Koech, O.K.[1] & Elhadi,Y. A. M.[1,3]
[1]Department of Land Resource Management and Agricultural Technology (LARMAT), University of Nairobi, P.O. Box 29053, Nairobi, Kenya
[2]Kenya Agricultural and Livestock Research Organization, Kiboko Research Centre, P.O. Box 12-90138, Makindu, Kenya
[3]Adaptation (ADA) Consortium, National Drought Management Authority, P.O Box 74247-00200, Nairobi, Kenya
Corresponding author: ndunguluiza@gmail.com

Abstract

Grasses among pastoral and agro-pastoral communities have for centuries been used for varying purposes. The objective of the study was to compare pastoral and agro-pastoral perceptions on the importance of indigenous grass species. Trends in abundance and accessibility of grazing lands in Kajiado and Makueni Counties were also compared. A total of 23 and 14 grass species were found to be common in Kajiado and Makueni Counties respectively. In both counties, livestock feeding was ranked highest at100% by the respondents. Thatching was second in both counties with income generation third in Makueni county and fourth in Kajiado county. Other grass uses were mulching, raw materials for silage and composite manure, and litter for chicken hatcheries in Makueni County. Declining trends of various indigenous grass species, quality and availability of grazing lands was mainly attributed to drought (96.8%, 98.2%), increased human population (85.7%, 78.2%), and overgrazing (60.3%, 65.5%) in Makueni and Kajiado counties respectively. Species such as *Panicum maximum* and *Digitaria macroblephara*, that are important but are declining are rarely studied, multiplied or promoted, such species should be further studied for their yield and nutritional value. Knowledge of variations within species and the preference of some varieties (ecotypes) over others by communities shed light on an existing knowledge gap amidst the scientific community. Further investigations should be carried out to look into the difference in nutritional status at different stages of growth, biomass and seed yielding capabilities as well as drought and grazing tolerance of the various ecotypes.

Key words: Ecotypes, native grasses, rangelands, trends

Résumé

Depuis des siècles, les graminées des communautés pastorales et agro-pastorales ont été utilisées à des fins diverses. L'objectif de l'étude était de comparer les perceptions pastorales et agro-pastorales sur l'importance des espèces d'herbes indigènes. Les tendances en matière d'abondance et d'accessibilité des pâturages dans les comtés de Kajiado et Makueni ont également été comparées. On a trouvé que 23 et 14 espèces d'herbes étaient respectivement communes dans les comtés de Kajiado et de Makueni. Dans les deux

comtés, l'alimentation du bétail a été classée à 100% par les répondants. Le chaume a été deuxième dans les deux comtés avec la génération de revenus, comme troisième dans le comté de Makueni et quatrième dans le comté de Kajiado. D'autres utilisations d'herbes étaient le paillage, les matières premières pour l'ensilage et le fumier composite et la litière pour les couveuses de poules dans le comté de Makueni. Les tendances à la baisse de diverses espèces d'herbes indigènes, la qualité et la disponibilité des pâturages ont été principalement attribuées à la sécheresse (96,8%, 98,2%), à l'augmentation de la population humaine (85,7%, 78,2%) et au surpâturage (60,3%, 65,5%) dans les comtés de Makueni et Kajiado respectivement. Des espèces telles que Panicum maximum et Digitariamacroblephara, qui sont importantes mais qui sont en baisse, sont rarement étudiées, multipliées ou promues ; ces espèces devraient être davantage étudiées pour leur rendement et leur valeur nutritive. La connaissance des variations au sein des espèces et la préférence de certaines variétés (écotypes) par rapport aux autres par les communautés font la lumière sur l'existence d'un manque de connaissances au sein de la communauté scientifique. D'autres études devraient être menées afin d'examiner la différence d'état nutritionnel à de différents stades de croissance, la biomasse et les capacités de production de semences ainsi que la tolérance à la sécheresse et au pâturage des différents écotypes.

Mots clés: Ecotypes, graminées indigènes, pâturages, tendances

Introduction

Dry lands of East Africa are characterized by seasonal variability of precipitation, sparse vegetation and the presence of agro pastoral and mixed farming systems centered on drought tolerant crops (Leeuw *et al.,* 2014). Livestock therefore plays a major role in the livelihoods of dryland communities in Kenya with the main species kept being cattle, sheep, goats and camels. Livestock production contributes 10% to the country's GDP and accounts for 50% of the agricultural GDP. A total of Ksh. 70 billion worth of the national livestock herd is estimated to be found in the ASALs of Kenya employing 90% of the inhabitants of these regions and accounting for up to 95% of dry land households' incomes (GOK, 2015).

Despite the importance of livestock production to household livelihoods, it faces a number of challenges, the key being shortage of adequate pasture and fodder both in terms of quantity and quality (Ndathi *et al.,* 2013).Over the years, livestock producers have been relying on natural pastures to meet the dietary needs of their animals. Natural pasture production in drylands however undergoes periods of surpluses, during the rainy season, and scarcity, during the drier periods. In cases of prolonged drought periods, high mortality rates become a reality. Competing uses of available grass species further worsens the situation.

A number of studies have been carried out in different parts of the country to understand the value of indigenous grass species to dryland communities (Wasonga *et al.,* 2003; Mnene, 2006; Opiyo, 2007; Mganga *et al.,* 2010; Ogillo, 2010; Ndathi *et al.,* 2012; Machogu, 2013, Mganga *et al.,* 2015; Kirwa *et al.,* 2015). Key attributes used to determine usefulness

of indigenous species include nutritive quality, seed yield and quality, livestock preference and digestibility (Machogu, 2013). The study therefore sought to compare the perception of pastoral and agro-pastoral communities towards the importance of indigenous grass species. Trends in abundance and accessibility of grazing lands in Kajiado and Makueni Counties were also compared.

Description of the study

The study was carried out in Makueni and Kajiado counties in Kenya. Makueni county is situated at 600m above sea level and lies between latitude 1^0 35' and 3^0 00' South and longitude 37^0 10'and 38^0 30' East (GOK, 2013). The region experiences two rainy seasons with the long rains occurring from March to April, while the short rains occur from November to December. The area receives between 800 and 1200mm of rainfall per year in the highlands (Mbooni and Kilungu hills), and 300-400mm per year in the low lands. Temperatures range from 20.2^0C to 35.8^0C, with the highest temperatures being recorded in the lowlands of the county during the dry spells, which occur between May and October (GOK, 2013).

Kajiado county is situated in southern Kenya, bordering Nairobi, Narok, Nakuru, Kiambu, Taita taveta, Machakos and makueni counties to the North east, West, North, South east, and east respectively. It lies between 36^0 5' and 37^0 5' East and 10^0 0' and 20^0 0' South. It experiences bimodal rainfall with long rains occurring between March and May and the short rains between October and December. Rainfall amounts range between 300mm per year in the Amboseli basin and 1250mm in Ngong hills and the slopes of Mt Kilimanjaro. Temperatures in the county range between 10-34^0C, with the coolest months occurring between July and August while the hottest being between November and April. (GOK, 2013a).

A comprehensive literature review was used to identify the key indigenous species based on the community's preference. Focus group discussions (FGD) and key informant interviews (KIIs) with knowledgeable members of the community were used to validate the findings from literature review. Data during FGDs and KIIs was collected using a semi-structured questionnaire. During the FGD and KIIs, participants were asked to list key grasses, give uses of the listed grasses and rank them, giving reasons for their rankings. They were also asked to give reasons for any trends in abundance and accessibility of natural pastures for grazing observed. Pair-wise ranking was used to rank reasons for trends observed. A total of 18 and 21 key informants were interviewed in Kajiado and Makueni county respectively. 6 FGDs were conducted in each county. Data entry and analysis were done using Microsoft excel 2010.

Results and Discussion

A total of 22 and 14 grass species were found to be common in Kajiado and Makueni county respectively. *Eragrostis superba* was the most abundant grass in Makueni county

while *Digitaria macroblephara* was the most common species in Kajiado county. A study by Hatch *et al.* (1984) in Makueni county listed 20 important native grass species based on species composition and cattle preference; *Digitaria macroblephara, Cenchrus ciliaris, Themeda triandra, Chrysopogon plumulosus, Cynodon plectostachyus, Chloris roxburghiana, Eragrostis superba, Panicum maximum, Enteropogon macrostachyus, Sporobolus fimbriatus, Bothriochloa insculpta, Eustachys paspaloides, Pennisetum mezianum, Echinocloa haploclada, sehima nervosa, Heteropogon contortus, Eragrostis superba, Digitaria milinjiana, Orepetium thomazum,* and *Cymbopogon pospichilii*. Of the 20 species, ten species have been identified as being important to dryland communites in Southern Kenya (Machogu, 2013) namely, *Eragrostis superba, Cenchrus ciliaris, Enteropogon machrostachyus, Chloris roxybughiana, Cynodon plechtostachyus, Digitaria machroblephara, Panicum maximum* (Guinea grass)*, Themeda triandra (*Kangaroo grass), *Botriocloa insculpta* (Sweet pitted grass)*,* and *Cymbopogon pospichilii.* The study identified only seven species *(Digitaria macroblephara, Cenchrus ciliaris, Themeda triandra, Chloris roxburghiana, Eragrostis superba, Panicum maximum, Enteropogon macrostachyus)* in common.

Four species, (*Cenchrus ciliaris, Chloris roxybughiana, Eragrostis superba*, and *Enteropogon machrostachyus*) have largely been studied and promoted in this region (Mnene 2006; Opiyo 2007; Mganga *et al.,* 2010; Ogillo, 2010; Ndathi *et al.,* 2012; Machogu 2013, Mganga *et al.,* 2015; Kirwa *et al.,* 2015). Species such as *Panicum maximum* and *Digitaria macroblephara*, that are important but are declining are rarely studied, multiplied or promoted. Preference of *C.ciliaris* by pastoral and agro-pastoral communities in the study area for its drought resistance quality agrees with finding of studies by Mganga *et al.,* 2015 and Wasonga *et al.,* 2003. *C.ciliaris* was ranked as the overall most important grass due to its versatility in use. Wasonga, 2003 and Ogillo, 2010 found *C. ciliaris* to be preferred by farmers due to its ability to increase milk yield. Macharia and Ekaya (2005) found *D.macroblephara* to be an important grass species among the pastoral communities in Kajiado county due to its perceived ability to increase amounts of milk produced by livestock as well as its ability to fatten livestock. These results were mirrored in this study.

Grass use

Grasses among pastoral and agro-pastoral communities have for centuries been used for varying purposes. Livestock feeding, thatching, income source, litter for chicken hatcheries, soil cover, raw materials for silage and composite manure, beddings, making brooms and aesthetic appeal were the uses stated in the study area. In both counties, livestock feeding was ranked highest by 100% of the respondents while thatching was ranked second. In Kajiado, thatching was mentioned as a grass use by 100% of the respondents while only 96.8% of the respondents mentioned it in Makeuni County. This was attributed to the declining availability of preferred species for thatching; such as *Themeda triandra* and *panicum maximum*; as well as the increased accessibility of iron sheets for roofing purposes. Income generation was ranked third in Makueni county with 28.6% of the respondents mentioning it as a use. It was ranked fourth in Kajiado County with 18.2% mentioning it as a use. Grass use for purposes such as mulching, raw materials for silage and composite manure, and litter for chicken hatcheries were only mentioned in Makueni County.

Table 1.1 Common grasses in Kajiado county

Scientific name	Common name	Local name
Cynodon plectostachyus	Giant star grass	emurua(enkaiemurua)
Cenchrus ciliaris	african fox tail	Osangash/ entimonyua
Setaria pumila	Yellow fox tail	Olonyoro
Digitaria macroblephara	Wooly finger grass	Erikaru
Oplismenus composites	Running mountain grass	Olpalakai(embalakai)
Themeda triandra	Red oat	Olokujita onyoike
Unidentified	Unidentified	Oloiyeti
Unidentified	Unidentified	Olkereiyan
Unidentified	Unidentified	Olerubat
Hyparrhenia hirta(L) Staph	Thatching grass	erashe/orasha
Cynodon dactylon	Couch grass	Olopiripiri
Pennisetum mezianum		Olongoro oing'ok
Unidentified	Unidentified	Enkarmarlasiai
Unidentified	Unidentified	Oloibarlupa
Enteropogon macrostachyus	Bush rye	Enkujitarangai
Unidentified	Unidentified	Oloyo
Aristida keniensis	Needle grass	Olkirian
Bracharia brizantha Staph	Signal grass	magutian/ormagutian
Cenchrus ciliaris(small, purple headed variation)		Engamba
Unidentified	Unidentified	Orngirimatian
Unidentified	Unidentified	Oloyaipasei
Eragrostis superb	Maasai love grass	Entepe

Table 1.2 Common grasses in Makueni county

Scientific name	Common name	Local name
Eragrostis superb	maasai love grass	Mbeetwa
Cenchrus ciliaris	african fox tail/ buffel grass	Ndatakivumbu
Chloris roxibugyana	horsetail grasss	Kileeli
Enteropogon macrostachyus	bush rye	Nguu
Cynodon dactylon	couch grass	Ikoka
Aristida keniensis	wire grass	Lamunyu
Digitaria macroblephara	wooly finger grass	Uiye
Dactyloctenium aegypticum	crow foot grass	Kikuukuu
Panicum maximum	guinea grass	Mbweya
Themeda triandra	red oat grass	Mwena
Unidentified		Kaukati
Setaria spp		
Hyperhenia spp		
Chloris gayana	boma rhodes grass	Kikaatu

Other important attributes of grasses include biomass production, and ability to tolerate drought. Ranking of the different grass species was based on their grazing value, biomass production and drought tolerance. *Dactyloctenium aegypticum* (crow foot) and *Enteropogon machrostachyus* were ranked as the most preferred grass species by livestock in Makueni

county. This was attributed to the ease of germination of these species thus making them readily available at the start of the rainy season. Ogillo (2010) found *E. macrostachyus* to have a high germination percentage (98.7%) compared to other range grass species. *Cenchrus ciliaris* (buffel grass) and *Cynodon dactylon* (star grass) were the most preferred dry season pasture. This was attributed to their ability to tolerate drought conditions thus making them readily available.

Digitaria macroblephara (wooly finger grass) and *Themeda triandra* (red oat) were the most preferred species in Kajiado county by livestock (Table 1.1). Their palatability was attributed to the "softness" of its leaves and stems. *D.macroblephara* was highest ranking due to its ability to fatten cows, and increase milk yield of livestock. *C.ciliaris, Bracharia brizanthia*, and *Pennisetum meziunnum* were the most preferred dry season pastures in Kajiado County. *C.ciliaris* and *P.meziunnum* were preferred due to their abundance in the dry season. *B. brizanthia* grew mainly in higher altitudes that served as dry season grazing grounds. It was however ranked as the least drought tolerant species.

Community perception of natural pasture trends

Composition and trend of range grass species in Kenya's Southern rangelands have been changing over the years (Table 2). Natural pastures in both counties were perceived to be both increasing and decreasing. Species with an increasing trend were primarily introduced or promoted species. *C.ciliaris, E.macrostachyus, E.superba,* and *Chloris roxibourgiana* have been promoted in the Southern rangelands of Kenya for rehabilitation and natural pasture improvement purposes (Mnene, 2006; Ogillo, 2010; Machogu, 2013). Drought (96.8%, 98.2%), increased human population (85.7%, 78.2%), and overgrazing (60.3%, 65.5%) were ranked as the key reasons for declining trends in various grass species in Makueni and Kajiado counties respectively. Previous studies have attributed the downward trends in quality, quantity and accessibility pastures and grazing lands to increased human and animal populations, sedenterization of the pastoralists, changes in land use, overgrazing, drought, land subdivision, lack of adequate seeds and soil erosion (Gitunu *et al.,* 2003, Macharia and Ekaya, 2005; Mnene, 2006; Bii, 2008; Kirwa *et al.*, 2012).

A study by Kirwa *et al.* (2012) attributed increased human population in Machakos to land subdivision, improved infrastructure and social amenities. Coupled with sedentirization, increased human and animal populations, increase pressure on the available grazing resources. Land subdivision and changes in land use further reduce the amount of available grazing resources by changing the plant community structure and the loss of important plant species as parcels of land are cleared to make room for alternattive uses. The effects of drought are thus exacerbated by the above factors (Gitunu *et al.,* 2003, Ndung'u *et al.,* 2003; Kirwa, 2009; Kirwa *et al.,* 2012). The declining trend of some species has been "arrested" by the deliberate cultivation of grasses as an alternative form of livelihood.

Improved livestock breeds have been introduced into rangelands so as to optimize the limited resources. The poor adoption of pasture improvement technologies counters the positive effects of improved livestock breeds. Mnene (2006) attributed the poor adoption of pasture improvement practices to lack of awareness on the need to do so as well as the lack of the technological knowhow by rangeland communities.

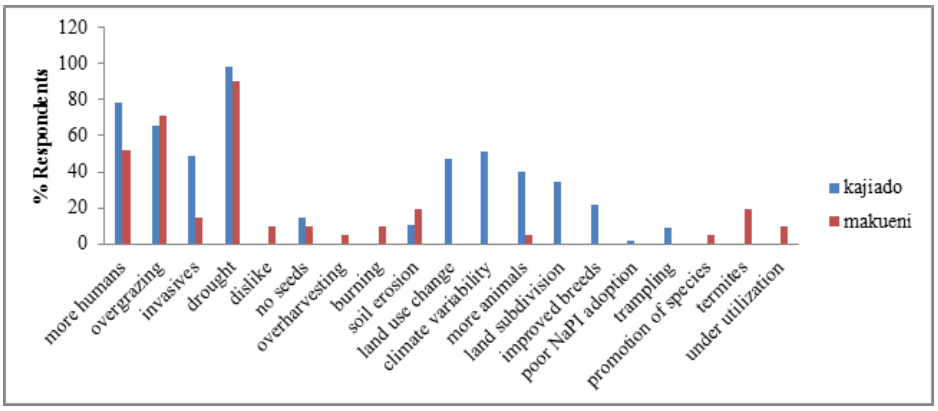

Figure 1: Reasons for declining trends of pastures in Southern Kenya

Table 2: Community concepts on trends of various grass species in Makueni and Kajiado county

County	Trends	Reasons
Makueni	Declining trends	
	Themeda triandra	Overgrazing
	Cynodon dactylon	Drought
	Digitaria macroblephara	Increased human population
	Panicum maximum	Increased animal population
		Invasive species
		Poor soils
Kajiado	Declining trends	
	Digitaria macroblephara	Overgrazing
	Hyperhenia hirta	Drought
	Cynodon plectostachyus	Increased human population
	Cynodon dactylon	Increased animal population
	Eragrostis superb	Invasive species
		Climate variability
		Invasive species
		Land use change
		Low adoption of natural pasture improvement technology
		Poor soils
		Keeping Improved animal breeds
Makueni	Increasing trends	
	Aristida keniensis	Reduced soil fertility
		Overgrazing
	Chloris gayana	Promotion for rehabilitation and fodder purposes
	Eragrostis superb	Keeping improved animal breeds
	Pennisetum purperium	Purposeful cultivation and protection of grasses
	Cymbopogon pospichilli	
	Sorghum sudanenses	
Kajiado	Increasing trends	
	Pennisetum meziunnum	Promotion for rehabilitation and fodder purposes
	Chloris gayana	Keeping improved animal breeds
	Pennisetum purperium	Purposeful cultivation and protection of grasses
	Digitaria macroblephara	

Community perception on variations within native grass species

Five varieties of *C. ciliaris*, three of *E. superba*, two of *E. macrostachyus*, two of *T. triandra* and three of *Chloris roxibourgyana* were described. Varieties were identified based on differences in leaf, stem, inflorescence and height characteristics. Some varieties were preferred to others. The short, purple headed variety of *C.ciliaris* for example was preferred to other varieties due to its perceived salty taste that makes is more palatable to livestock (Table 3).

Table 3: Descriptions of variations observed within various indigenous grass species in Makueni and Kajiado counties

Species	Variety	Description
Cenchrus ciliaris	1	Hard short stems, more stems than leaves, good seeder, grayish inflorescence and found growing in drier areas
	2	Short, soft, slender stems, leafy with purple inflorescence, has salty taste
	3	Tall grass with whitish leaves, white-blue inflorescence, long broad leaves, found growing in areas with water
	4	Hard, long stems, more stems than leaves, purple inflorescence.
	5	Tall grass with soft stems, creeping growth habit, highly preferred by livestock, poor seeder, leafy with a white inflorescence
Chloris roxibourgyana	1	Tall grass with broad leaves; most of them basal, slender stems, white inflorescence
	2	Broad leaves, hard stems, purple inflorescence and not preferred by livestock
	3	Broad leaves, hard stems, blue inflorescence
Enteropogon machrostachyus	1	Slender stems and leaves, leafy with a short purple inflorescence
	2	Tall thick stems, leafy with a white inflorescence
Eragrostisi superba	1	Tall soft stems, good seeder, leafy with a purple inflorescence
	2	Tall hard stems, more stems than leaves, large white-blue inflorescence
Themeda triandra	1	Tall, tufted, more stems than leaves, red inflorescence
	2	Short, leafy, red inflorescence

Knowledge of variations within species and the preference of some varieties over others by communities shed light on an existing knowledge gap amidst the scientific community. (Table 3). While numerous studies have been carried out to determine the best suited indigenous grass species for various areas, few studies have concentrated on looking at the various varieties (ecotypes) of these species adapted to specific areas and their importance

in ensuring a continued supply of high quality forage. Ogillo (2010) described *C. ciliaris* as being an extremely variable species. Kirwa *et al.* (2015) investigated the differences in mophometric and nutritional characteristics of different ecotypes of *Cenchrus ciliaris* and *Eragrostis superba* collected from different parts of the country and grown under similar conditions. The study recommended that further investigations should be carried out to look into the difference in nutritional status of the various ecotypes at different stages of growth. An understanding of such variations provides an opportunity for the exploitation of the different ecotypes so as to meet the feed requirements of animals depending on the management objectives of the livestock keeping enterprise.

Conclusion

From this study, we drew the following conclusions;

- Importance placed on a particular grass species by both pastoral and agro pastoral communities varies with the intended use as well as the season.
- Grazing value, high seed and biomass yielding capabilities, drought and grazing tolerance are key attributes to consider when breeding and promoting indigenous grass species for enhanced fodder production or land rehabilitation purposes.
- Knowledge of variations within species and the preference of some varieties (ecotypes) over others by communities shed light on an existing knowledge gap amidst the scientific community.
- Further investigations should be carried out to look into the difference in nutritional status at different stages of growth, biomass and seed yielding capabilities as well as drought and grazing tolerance of the various ecotypes.

Recommendation

- Important species on a declining trend such as *Panicum maximum* and *Digitaria macroblephara* should be further studied for their yield and nutritional value.
- Existing ecotypes of important grasses should be further studied to investigate any differences in biomass and seed yielding capabilities, drought and grazing tolerance and nutritional value.

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