

FACTORS INFLUENCING MANAGEMENT OF RANGELANDS BY PASTORAL COMMUNITIES IN GOTU, NGAREMARA WARD, ISIOLO COUNTY, KENYA

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ABSTRACT

This study aims to examine the factors that influence management of rangelands by Kenyan pastoral communities particularly in Gotu area in Ngare Mara Ward, Isiolo County. The study was guided by the following research objectives: To establish the influence of size of livestock herd on management of rangelands in Gotu area; to examine the influence of community management structures on management of rangelands in Gotu area; to determine the influence of government support on management of rangelands in Gotu area; to establish the influence of socioeconomic status of community on management of rangelands in Gotu area. The study targeted all the male and female inhabitants of Gotu area in Ngare Mara Ward. The researcher also interviewed the current governor of Isiolo County, Hon. Godana Doyo. Questionnaires and interview schedule were used to collect the data. The collected data was organized and prepared for analysis by coding and entry in the Statistical Package for Social Sciences (SPSS, Ver.19). The study found that size of livestock motivates conservation of the grazing land, that local communities frequently engage in any grazing land conservation activities, that government have put measures to support management of local grazing land and that local community's occupation prompts their management of grazing land. The study also revealed that large herds of livestock knock down dead plants making them decay more

quickly and fertilize the soil end ensure healthy grazing lands, improvement of degraded grazing land means more pasture for more livestock and that conservation of grazing land ensures its long-term productivity for the increasing herds of livestock. The study revealed that some of the conservation activities include monitoring livestock physical characteristics to evaluate the quantity of pasture, that regulating the frequency of daily livestock movements, rotation grazing to avoid overgrazing, closing off degraded pastures for several years to allow regeneration and maintaining an appropriate herd structure for a suitable time. The study concluded that size of livestock herd had the greatest influence on management of rangelands in Gotu area followed by community management structures then socio economic status while had the government support then least effect on the management of rangelands in Gotu area. The study recommends that there is a need to strengthen the management capacity of rangelands through measures that enhance pastoralists' control over natural resources, that there is need to build capacity and skills of people to harvest and store rain water and surface run-off and to sensitize the communities on rangeland restoration techniques.

Key Words: *management, rangelands, pastoral communities, Gotu, Ngaremara ward, Isiolo County, Kenya*

INTRODUCTION

Rangelands are defined as vast natural landscapes in the form of grasslands, shrublands, woodlands, wetlands, and deserts (Colson, 2018). Across the Europe, Asia, and United States, and South America rangelands are crucial sources of water, mineral resources, and wood products. The rangelands are also preferred destinations for wildland recreation, open space and natural beauty recesses (Spencer, 2014). African rangelands are symbolized by a diverse floristic mosaic. Adegboye (2015) observes that these rangelands are characterized by patches of grasslands and pure shrub thickets mixed with open canopy savannas and wooded Acacia steppes. On the fringes of ecosystems, the vegetation variety can be sharp or gradual, in both cases resulting in very special and diverse flora. African rangelands are predominantly used for livestock grazing. They are also crucial wildlife habitats.

According to Wario (2016), rangelands make up for 85% of the land surface area in Kenya. Types of rangelands in Kenya include short grass prairies, desert grasslands and shrublands, savannas, and chaparrals. Just like in other African countries, Kenyan rangelands are largely inhabited by nomadic pastoralists who are principally dependent on livestock. In adapting to a harsh and variable physical environment in the rangelands, the Kenyan pastoralist has developed principles and strategies for managing natural resources. Hamisi (2014) points out that coordination among herding units among pastoral communities in Kenya is ensured by a higher level of authority and occasionally by a set of formal rules. For example, according to Borana rules, large ceremonies are held only when and where there is enough pasture and water to support those attending (Godana, 2017). The Somali and the Masaai have similar rules (Sankale, 2015). Wario (2016) adds that the council of elders of the Il Chamus of Kenya enforces grazing controls through informal 'police' chosen from members of the 18-30-year-old age set. Again, three basic informal rules are common to all Kenyan pastoralists: avoid areas already in use, keep at an appropriate distance from others, and avoid areas just recently vacated by others (Njogu, 2018).

These social rangelands controls among Kenyan pastoralists, both formal and informal have successfully obviated the need for external natural resource management campaigns (Hamisi, 2014). This is mainly because these controls are enforceable through the traditional power of the leadership, the individual's need for conformity and acceptance, and the need for reciprocity and mutual help. The communities believe that sharing common property means that short term restraint and discipline has to be exerted in order to maintain the rangelands' long-term sustainability (Sankale, 2015).

The survey and synthesis of existing literature shows that Kenyan pastoral groups use a wide range of techniques in managing natural resources in the rangelands. Their systems are neither random nor irrational, but quite deliberate and adapted to the vagaries of their environment, meaning they are influenced by particular aspects that most current and previous studies have

greatly overlooked. This study seeks to pay close attention to these aspects by examining the factors influencing management of rangelands by pastoral communities in Kenya with specific reference to Gotu area in Ngare Mara Ward, Isiolo County.

STATEMENT OF THE PROBLEM

In the recent years, the Kenyan pastoralist has had to face new external pressures, such as crop expansion into high quality rangelands, nationalization of land by governments, population increase, overgrazing, and indiscriminate water development. These problems have been compounded by a relentless series of droughts and conflicts. These external pressures have contributed to pasture shortages, land degradation, and socio-economic disintegration. Although many pastoralists are changing their ways (for example diversifying into crop cultivation, sending relatives off for urban wages, or engaging in commerce and trade) many continue to manage their livestock in the old way (Njogu, 2018). But in many areas their traditional system of management is no longer able to cope with the shortage of pasture or to manage the consequences of drought. At the same time, these systems have not been able to adequately balance community needs or sizes of herds owned by their members; hence frequent intercommunity conflicts for scarce rangelands and environmental degradation. In addition, traditional management knowledge systems are gradually being lost as more of the younger generation of pastoralists is attracted to urban areas. Yet the local communities' system have over centuries developed an intimate knowledge of the environment and many successful techniques that are of great use in the rangelands today. This study therefore seeks to sensitize the scholarly world as well as the next generation of pastoralists on the pivotal role played by communal rangelands management systems in Kenya; and how these systems, if mixed with certain modern methods, will improve environmental sustainability of pastoral physical environments and better sustain their socioeconomic system. The current study sought to accomplish this by exploring the factors influencing management of rangelands by pastoral communities in Kenya, with specific reference to Gotu area in Ngare Mara Ward, Isiolo County.

PURPOSE OF THE STUDY

This study aimed to closely examine the key factors that influence management of rangelands by pastoral communities particularly in Gotu area in Ngare Mara Ward, Isiolo County.

RESEARCH OBJECTIVES

1. To establish the influence of size of livestock herd on management of rangelands in Gotu area
2. To examine the influence of community management structures on management of rangelands in Gotu area
3. To determine the influence of government support on management of rangelands in Gotu area

4. To establish the influence of socioeconomic status of community on management of rangelands in Gotu area

LITERATURE REVIEW

Rangelands Management

Rangelands management involves the use of a practical decision-making process that effectively deals with complex rangeland environment from a holistic perspective. According to Spencer (2014) Using rangeland management, people dependent on rangeland areas begin to view their environmental management options in a whole new way, which in turn affects the way they make socioeconomic management decisions. This approach is innovative and yet elegantly simple. When one views the rangeland through a holistic lens and monitors all of the ecosystem processes (water cycle, mineral cycle, energy flow, and biological community dynamics) then rangeland management addresses the whole. The community can then manage animals to manage land, water, and biodiversity (Wario, 2016).

Size of Livestock Herd and Rangelands Management

Pastoralists always try to maintain a diverse portfolio of livestock designed to meet their needs and to fit the environment. Each type of animal fills a specific objective of the pastoral family. According to Grootaert and Bastelaer (2011), large animals (cattle and camels) are raised not so much for their meat as for their milk, but they are also the ‘bank account’ and ‘security deposit’ of the pastoralist. Unlike Middle Eastern breeds, African sheep and goats are not kept primarily for their milk but for their meat, their ‘liquidity’, and to a lesser extent, their hair. Other animal products are certainly valued (such as manure and hides) but do not seem to factor in pastoral decisions on the composition of their herds (Jodha, 2014).

As observed in the preceding chapter, African rangelands are characterized by a diverse floristic mosaic. Patches of edaphic grasslands and pure shrub thickets can be mixed with open canopy savannas and wooded Acacia steppes. On the fringes of ecosystems, the ecotones can be sharp or gradual, in both cases resulting in very special and diverse flora (Diop, 2014). Modern ranchers in East Africa, raising solely cattle, have had to expend much capital and labour for bush clearing in order to maintain the rangelands. This is in marked contrast to the traditional African pastoralist who accepted and adapted to environmental diversity by having a herd of mixed species. Cattle and sheep rely in large part on grass (but also some forbs and browse especially in the dry season), while camels and goats rely mainly on browse (Mwangi and Dohrn, 2017).

In an effort to manage the rangelands, African pastoralists practice herd splitting. Herd splitting, the practice of dividing the livestock into separate herds depending on their age, sex, type and productivity, is widely practiced in Africa. Mwamfupe (2016) asserts that pastoralists frequently separate large ruminants from small ones, as among the Rendille of Kenya; herd camels together

with sheep, and cattle with goats, as done by the Twareg of Niger; and separate livestock into a 'milk' herd (mostly milking and pregnant animals and their young), and a main or dry herd, as among the Fulani of northern Senegal and the Dinka of Sudan. Herd splitting results in increased niche specialization; reduced competition among livestock for the same vegetation; and a dispersion of grazing pressure as each type of livestock is taken to the pasture which suits it best. Those who do not split herds often do not have enough livestock or herders, or both. Herd diversity and splitting are techniques that can be used to maintain the long term productivity of the range; ensure sustainable production at a comparatively low cost; and in some cases improve degraded rangelands (Maganga, 2015). For example, the Maasai herd their flocks of goats in such a way as to reduce bush encroachment (Sankale, 2015).

Overgrazing has been faulted for degrading lands. Yet, perhaps what has not been recognized universally is what overgrazing really is. According to Lunde (2013), overgrazing is a function of time, not animal numbers and occurs when an animal returns to a grass plant before it has had time to regenerate. When animals are allowed to roam at will, they will indeed revisit plants before the plants can recover. However, when animals are herded so as to ensure that they do not re-graze plants before they have recovered, then overgrazing is no longer an issue. Time governs the effects of trampling too. Animal hooves enhance soil health when they chip sealed soil surfaces, and knock down dead plants so they can decay more quickly. But they cause damage if animals remain in one place too long or return to it too soon (Kaswamila, 2016).

By combining small groups of animals into larger herds and planning their daily moves, herdsmen maximize forage production and the benefits of animal impact – the hoof action of the animals as well as the dung and urine that fertilize the soil. To illustrate this, Butz (2014) explains that by mimicking the wild herds that roamed these lands in the past and keeping livestock moving, they minimize overgrazing of plants, which over time leads to increased ground cover. Livestock are, in effect, being used as a tool for improving soil aeration, water penetration, seed germination, and increasing species diversity and productivity. Rivers begin to flow again because water retention in soils is increased, leading also to more secure and lasting boreholes (Young and Cauldwell, 2014).

Community Management Structures and Rangelands Management

The main production objectives of pastoralists are not just increasing herd size, but also increasing milk yield, maintaining an appropriate herd structure for short and long term reproductive success, and ensuring disease resistance by selective breeding (Spalding and Jenkins, 2011). The priorities given to each goal will change depending on a pastoral community's agility to conserve their immediate environment- the rangeland by prudent herding. Herding is the art of guarding and conducting livestock. Not every pastoral community has the aptitude and skill in herding. For example, among the Samburu of Kenya, the more distant pastures are underutilized because they are only used by the more energetic and better managers

(Hamisi, 2014). The art of herding may be fast disappearing as more and more young people leave the range, but the alternative to herding - fencing - is not feasible for the majority of pastoralists. This is because herders from the same social unit are usually free to use any part of their territory, but in practice confine themselves to the range they know best, and prefer to stay with the same group of people, especially relatives. This usually ensures a continuity and consistency in range use by the same managers (Jama and Zeila, 2015).

Nonetheless, most pastoral groups have several types of range management techniques including pasture rotation/deferment and grazing reserves. These techniques are frequently used to save forage for critical periods. For example, Nefzaoui, et al (2014) observe that the Zaghawa of Chad move their sheep and camels north to Sahara pastures in separate parallel paths, leaving a portion of the range ungrazed for their return journey to the south. Except during a drought, the Pokot defer using areas with termite-resistant grass during the wet season in order to preserve good fodder for the dry season (Njoka, 2017). The Maasai will widen their grazing radius and delay entering the dry season areas by using donkeys to transport water (Sankale, 2015), and in Amboseli National Park this strategy has been shown to increase the total carrying capacity by 50% (Kideghesho et al, 2017).

Apart from such large-scale rotations, herders also have formal and informal rules regulating the frequency of daily movements and camp locations. Khwaja (2014) reveals that the Wodaabe Fulani use lunar cycles to time their movements to new pastures, which in effect results in moving camp every 2-3 days and moving out of an area every week. This system is apparently common to all Fulani groups, but the Wodaabe observe it more strictly. The Fulani of northern Nigeria say that they must move camp at least four times each season (they recognize five seasons) to prevent over-use (Adegboye 2015).

Herders also closely monitor their livestock and environment for signs that indicate a need to move and the best direction to go. Khwaja (2014) points out that the Wodaabe monitor livestock feces, milk yield, animal weight, and the number of cows in heat to evaluate the quantity of forage. The Fulani of Mauritania evaluate the quality of the range by taking the livestock to the same pasture on an experimental basis for seven consecutive days. During this time they examine the soil types, the presence or absence of key forage species, the behaviour of livestock (sleeping pattern, eating schedule and the quality of skin and hair, etc.), and presence or absence of wildlife. Good pastures, for example, support gazelles and wild boars, bad ones are inhabited by vividly coloured lizards, and pastures used by elephants and ostrich are good only in the dry season (Okayasu et al, 2011). There are also many indicators for monitoring pasture degradation. For example, the Samburu observe grass and browse availability (Njoka, 2017), and the Fulani of Mauritania monitor specific plants and wildlife (Okayasu et al, 2011).

These traditional environmental indicators are still in use and have become more pertinent as resource shortages have increased. Up to now, these traditional rangeland monitoring systems

have not been used in the development context, perhaps because they did not fit into the classical fenced 'ranch' model. Their effectiveness, enhanced by modern husbandry techniques and the relatively low cost of hiring herders as local range monitors, are advantages that can form an integral part of more effective range development programmes. Local herders and scouts should thus be considered as field implementers of environmental monitoring programs and early warning systems.

In some ecological zones, rotation strategies can also be used to increase rangeland capacity by deliberate overgrazing. According to O'Reagain and Schwartz (2014), the Fulani of northern Sierra Leone practice 'shifting pasturage'; they overgraze one area for 2-3 years then move elsewhere and rest the first area for 15-20 years. The Sukuma (South of Lake Victoria) do the same but allow a rest period of 30-50 years (Mangora, 2015). However, not all ecological zones can withstand overgrazing. For example, in case of overcrowding, the Fulani of Nigeria send their surplus livestock to neighbouring territories where they have alliances (Adegboye 2015). The traditional range supervisors of the Tswana of Botswana were responsible for monitoring the range for overcrowding, and would suggest solutions to the community for allocating more rangeland or moving some herds out of heavily used areas (Tomoo, et al, 2011). Unfortunately, the information on traditional rotation strategies is very limited, perhaps because very few range managers have been interested in studying traditional systems.

Grazing reserves may be exceptions rather than the rule in Africa, but they have been found among more pastoral groups than previously thought. Vetter (2015) explains that some areas are formally declared as grazing preserves or livestock passages where no cultivation is allowed. These efforts to stop the encroachment of crops into rangelands have been documented among the Macina Fulani, the Tonga of southern Zambia, and the Luo of Kenya. Some reserves were set aside to save fodder for dry seasons, as among the Sukuma of Southern Lake Victoria, the Twareg of Ahaggar, the Il Chamus of Northern Kenya, and the Berbers of Morocco (Otsyina, et al, 2017). Groups such as the Rendille of Kenya and the Tilemsi of Mali reserved certain areas for drought years. In the latter case it appears that the drought reserves were eventually abandoned because the pastures were invaded by toxic plants, possibly due to over-rest (Mwangi and Dohrn, 2017). Finally, some groups closed off degraded pastures for several years to allow regeneration, such as the Berbers of Morocco (Larbi, 2014) and the Chiefs of Northern Burkina Faso, who could order the closure of wells and other water points (De Jode, 2014).

Government Support and Rangelands Management

Sound environmental governance, which builds on equitable and sustainable management of natural resources, plays a key role in supporting sustainable livelihoods and building lasting peace. The Government of Kenya (2016) delineates that in order to safeguard long-term equitable and sustainable environmental management, a clear and transparent relationship to land – whether an individual's, a community's, a government's or a private investor's – is essential.

As such, rangeland development policies and institutional set ups in Kenya and across Africa have evolved. Government institutions in African rangelands have existed and evolved over time. These institutions have been very instrumental in governing rights to water, land and rangeland resources, as well as in conflict resolution.

Pastoralism has been and continues to be the dominant land use system in Africa's rangelands. A key feature of the pastoral system is the strong social organization and customary institutions that have helped pastoralists to adapt to uncertainty and due to their flexibility have contributed to enhanced resilience in rangeland ecosystems (WISP, 2014a). Control of access and management of rangeland resources under traditional institutions has over time been weakened mainly by unsupportive policies and a tendency for state-centric natural resource management common in Africa (Tiedeman, 2015). However, the on-going process of democratization and devolution of power and resources is likely to have a positive impact on natural resource management in rangelands, but care must be taken to protect the vulnerable, voiceless and marginalized people and groups. The role played by the community in governance of natural resources has also gained more recognition and supportive policy is in place in some countries. For example, sectoral policies for forest and water in Kenya acknowledge and provide a framework for participation of communities and other stakeholders in resource management. This trend is also reflected through the emergence of community-based natural resource management (CBNRM) (Mureithi, 2011).

Nikola (2014) observes that over the years, rangeland development initiatives in Africa have advanced, with considerable differences across countries and the perceptions that pastoralism using communal rangelands was inefficient, had low productivity, and caused environmental degradation, led to pastoral policies that tended to favor sedenterization rather than promote pastoral mobility, resulting to widespread appropriation of pastoral rangelands, especially in Eastern and Southern Africa. However, due to better understanding of pastoral systems, this perception has changed and pastoralism is being viewed by African governments as a rational way (both economically and ecologically) of using the rangelands (Agade, 2016). The governments have thus developed policies and legal frameworks in support of pastoralism and in extension, rangelands management

At continental scale, the African Union is developing a Pan African pastoral policy framework which aims to secure, protect and improve the lives, livelihoods and rights of African pastoralists (African Union, 2016). Whilst the draft Framework Guidelines for Land Policy in Africa underscores the need to enhance access to land through tenure reform, particularly for vulnerable groups such as women, establishment of a process for resolution of cross boundary disputes which will help to protect grasslands and pastoral ecosystems (African Union, 2014).

Pastoral issues in Africa are also being captured within the bigger framework of climate change adaptation as rangelands are among the hardest hit by effects of droughts, floods and famine.

Regionally, the Economic Community of West Africa States (ECOWAS) has set the pace by providing a legislative framework for cross border mobility, in the form of an International Transhumance Certificate to be used by pastoralists in fifteen-member states (IIED and SOS, 2016). For the COMESA region, there is a 2009 draft policy framework for food security in pastoral areas, which seeks to harmonize national policies to support pastoral movement and efficient use of transnational rangeland ecosystem, and promote livestock trade (African Union, 2016).

Closer home, the East African Community (EAC) recently developed the EAC Transboundary Ecosystems Management Bill, to provide for the management and regulation of Transboundary Ecosystems in the EAC (EAC, 2016), which is expected to enhance management of rangelands particularly with regard to wildlife, pastoralism and water resources.

In Kenya, Njoka (2017) asserts that, national and regional policies guiding rangelands management and development have established a balance between pastoralism and agriculture. However, more efforts are still needed today to incorporate pastoralism into the mainstream economy by undertaking reviews of a wide range policies and making relevant changes, informed by a better understanding of the Kenyan rangelands.

All in all, opportunities for enhancing pastoral lifestyle and rangelands management by African governments through policy and institutional frameworks continue to emerge, for example, the on-going progressive regional integration where recognition of the need for mobility of pastoralists across border has been given priority.

Socioeconomic Status and Rangelands Management

Rangelands, though generally perceived by many to be of low significance, have supported people's livelihoods for thousands of years. Rangelands support life for those living within them and also for those living outside them. Key economic activities supported by rangelands include livestock production, rangeland agriculture, wildlife conservation and related activities and to a lesser extent mining.

However, as previously noted, the rangelands are predominantly used for livestock production, mainly through pastoralism. Data from FAO (2014) reveal that in sub-Saharan Africa alone, 25 million pastoralists and 240 million agro-pastoralists depend on livestock as their primary source of income. The region holds a 12.5 per cent share of the world's meat production, a large part of which originates from rangelands. In sub-Saharan Africa about 16 per cent of the population relies on pastoralism which contributes significantly to the Gross Domestic Product (GDP) of many nations, for example, approximately 8.5 per cent in Uganda, 9 per cent in Ethiopia and 10 per cent in Mali (CBD, 2016). In the Sahel region in countries such as Burkina Faso, Chad,

Mali, Mauritania and Niger, transhumance pastoralism (which is the dominant feature of pastoralism in the region) contributes an estimated 70 per cent to 90 per cent of cattle reared (Kamuanga *et al.*, 2017).

Land is the most fundamental among natural resources on which human existence and prosperity on the rangelands depends. Thus the importance of natural resources conservation in sustaining productivity and rangelands protection among pastoral communities is now relatively more realized than in the past. The pastoral communities understand that livestock production, which is the backbone of their existence, is primarily dependent on a sound rangeland ecosystem.

It is important to note that, Sub-Saharan African pastoralism involves highly fluid production systems responding flexibly to variable and unpredictable arid and semi arid rangeland environments (Karrou and El Mourld, 2013). Consequently, a critical feature of the pastoral production system is access to extensive public land offering potential grazing and water resources that afford pastoralists the necessary flexibility to relocate their livestock when local rangelands fail (Wario, 2016). For this reason, driven by the will to preserve their sole socioeconomic activity, the pastoral communities have taken up the collective responsibility of conserving the rangelands. This conservation is mainly restricted to macro- and micro-economic rangeland elements that harbour biodiversity resources and support livestock production. These include:

Preservation of pastures: This mainly because, Scarcity of pasture associated with the temporal and spatial variability of rainfall and human interference in the rangelands continues to be a challenge for sustainable use of rangelands in Africa. According to FAO (2016), there has been a reduction in pasture with the total land area under pasture and fodder having decreased in Africa, partially due to the fact that large grassland areas have been destroyed or converted to agricultural land. Demand for livestock feed preservation in the rangelands has therefore increased.

Water management: water management and/or conservation of available groundwater reduces the pressure on grazing resources. Mengistu (2015) observes that a few pastoral groups have formal organisations for controlling and managing communal wells. For example, the northern Somali have an elected committee of 3-20 water managers who allocate water to the community and guests, guard the well, enforce and devise rules of use, charge fees, and maintain the well. The Borana of southern Ethiopia have a council of well users that appoints a 'father of the watering order'. These organizational structures can be used to manage newly constructed boreholes, if the ownership of the well is officially transferred to the local people and if the users are trained in its maintenance (Jama and Zeila, 2015).

Fodder crop production and preservation: Fodder trees and shrubs constitute a major component of the diet of livestock in arid and semi arid zones of Africa (Otsyina *et al.*, 2017). It has also been noted that the integration of fodder shrubs into the production systems in the dry areas of

North Africa and Central and West Asia could reduce rangeland degradation and mitigate desertification (Larbi et al., 2014). The loss of indigenous perennials plants and shrubs in North Africa rangelands due increased population of people and livestock has therefore necessitated rehabilitation of denuded areas for example by reseeding the degraded areas with legumes (Kassahun et al, 2014). In sum, pastoral communities have acquired a wide knowledge of the ecosystems in which they live and of ways of using natural resources to sustain their socioeconomic lifestyles

THEORETICAL FRAMEWORK

This study will be based on the ecological succession theory developed by Henry Gleason in 1920. Gleason argued that species distributions responded individualistically to environmental factors, and communities were best regarded as artifacts of the juxtaposition of species distributions. According to the Gleasonian theory of ecological succession, disturbance becomes a part of the ecosystem and several stable communities have the potential to develop after disturbances are eliminated or reduced. The nature, frequency, and intensity of the disturbance differentially impact each plant species, therefore the community formed after a disturbance depends on the abilities of the species to survive the disturbance or to replace themselves through reproduction after the disturbance. The likelihood of a species surviving or replacing itself after a disturbance depends on the species germination characteristics, competitive ability, growth, phenology, and on its genetic variability and plasticity related to the myriad of environmental factors it may face. In short, forecasting the dynamics of a community following a disturbance requires the knowledge of the physiological and demographic responses of the individuals that constitute the interacting populations that form the community.

The Gleasonian-based successional theory as a model for vegetation conservation is in consistency with the current study's ecological thought regarding management of rangelands. The purpose of this paper is to examine the key factors that influence management of rangelands by Kenyan pastoral communities. Gleasonian successional theory, on the other hand, briefly describes current concepts of vegetation dynamics in relation to vegetation species interaction with populations that form the community. Thus, Gleason's theory of ecological succession is deemed utterly relevant for the current study.

RESEARCH METHODOLOGY

Research Design

Research design is a plan of action to be carried out in connection with the proposed research work. This study adopted a descriptive survey design. The choice of survey research as opposed to other research designs was motivated by the following factors. First, survey research provides a suitable instrument for collecting a large amount of data on similar data items over a short

period of time. This facilitates gaining insights into the situation as it is, within a very short time without elaborate and often expensive preparations or long waiting. Secondly it provides a practical framework for collecting data on the factors that influence management of rangelands by Kenyan pastoral communities in Gotu area in Ngare Mara Ward, Isiolo County. Thus, the survey study provided a suitable means of obtaining information that reflect the situation as it applies to all the stakeholders concerned with rangelands management among pastoral communities. Third, survey studies have strong data reliability. This provides information on the situation as it is at the time the study was conducted. The qualitative research techniques allowed the researcher to understand the subjects and consequently provide a means of accessing unquantifiable facts about them. It also enabled the researcher to formulate open-ended questions through which a deeper range of responses was sought. In addition, this study employed quantitative techniques to determine the influence of size of livestock herd on management of rangelands in Gotu area; the influence of community management structures on management of rangelands in Gotu area; the influence of government support on management of rangelands in Gotu area; and the influence of socioeconomic status of community on management of rangelands in Gotu area

Target Population

Barton (2001) cites that any scientific research targets a given population through which interview and questionnaires are distributed so as to target the desired or the required data for analysis. Thus, in conducting a research study researcher ideally investigated all the individuals to whom they wish to generalize their findings. These individuals constitute a population, meaning that they make up the entire group of individuals having the characteristics that interest the researchers (Gall, 2013). In this study, the target population includes all the male and female inhabitants of Gotu area in Ngare Mara Ward. According to Gall, a target population provides a solid foundation and first step upon which to build population validity of the study. Thus, the researcher also considered population characteristics such as gender, age, education level and occupation, of the participants in the study. The researcher collected data from a representative sample composing of men and women residing in Gotu area. The researcher also interviewed the current governor of Isiolo County, Hon. Godana Doyo.

Sampling Procedures

According to Gall (2013), the general rule in quantitative research is to use the largest sample possible. The larger the sample, the more likely are its mean and standard deviation to be representative of that of target population (Ogula, 1998 p. 59). In this study, the researcher intends to collect data from a representative sample composing of residents of Gotu area and the Isiolo County governor as well.

Sample of Residents

During this study, cluster sampling was used. A mixture of stratified and simple random procedure was used to select a representative sample of residents, from a cluster, who participated in the study. First the researcher classified the residents into five (5) major stratas, that is, the five major regions of Gotu areas namely: Oldonyiro, Rahole, Merti, Kinna, and Garba Tula. In each of these five zones, the researcher randomly selected only one (1) development-oriented welfare group. In each of these welfare groups, the researcher randomly selected a representative sample of sixteen (16) group members. The researcher obtained the list of names of all the members of each welfare group from the group secretaries. These names was noted down on different slips of paper, which was placed in a container and mixed thoroughly. The researcher then picked 16 names from the container. This was done in every selected welfare group (5) to give a total of 80 members (N=80). To ensure gender impartiality in the study, the researcher called for, and encourage the participation of balanced male to female ratio in each particular group. Table 3.1 shows the summary of the sample. The Isiolo County governor was purposively sampled because he is only one (1).

Methods of Data Collection

In this study, questionnaires and interview schedule was used. The questionnaire was used since it facilitates data collection within short timeframe. On the other hand the interview method was used because it collects in-depth data and allows guided discussion among the participants with the researcher acting as the facilitator (Mwiria and Wamahiu, 2017). The questionnaires was used with the residents of Gotu area whereas the interview guide (semi-structured) is intended for the Isiolo County governor. The Questionnaires for residents had a number of sub-sections that are sub-divided based on the research objectives except the first sub-section (Section A) that is meant to capture the demographic characteristics of the participants. Section A: Demographic characteristics of residents (sex, age, educational background, occupation); Section B: Influence of size of livestock herd on management of rangelands; Section C: Influence of community management structures on management of rangelands; Section D: Influence of government support on management of rangelands; Section E: Influence of socioeconomic status of community on management of rangelands and Section F: Management of Rangelands. A semi-structured interview guide was used to collect data from the Isiolo County governor. The interview guide consisted of two main sections. Section A covers the demographic characteristics of the participant. Such characteristics include age and administration experience. Section B addresses the main research questions on the factors that influence management of rangelands by Kenyan pastoral communities in Gotu area.

Methods Data Analysis

The collected data was organized and prepared for analysis by coding and entry in the Statistical Package for Social Sciences (SPSS, Ver.19). The researcher used both descriptive statistics such as frequencies and percentages. The number of responses (response rate) against the questionnaires sent to participants were determined. Subsequently, coding, classification and grouping of the data according to the predetermined criteria of the received data was done. Quantitative data was presented in the form of tables and graphs with accompanying descriptive details. Quantitative data, which formed the bulk of the study, was analyzed using quantitative methods in order to establish findings and conclusions based on the research questions of the study.

RESEARCH RESULTS

The study sought to establish the influence of size of livestock herd on management of rangelands in Gotu area. The study found that size of livestock motivates conservation of the grazing land in Gotu. The study also revealed that large herds of livestock knock down dead plants making them decay more quickly and fertilize the soil and ensure healthy grazing lands, improvement of degraded grazing land means more pasture for more livestock and that conservation of grazing land ensures its long-term productivity for the increasing herds of livestock. Further, the study found that sustainable production of the large herds of livestock is maintained by well-preserved grazing lands and that animal hooves don't enhance soil health when they tramp on solid soil surfaces thus enhancing pasture growth.

The study further sought to examine the influence of community management structures on management of rangelands in Gotu area. The study found that local communities frequently engage in any grazing land conservation activities. The study revealed that some of the conservation activities include monitoring livestock physical characteristics to evaluate the quantity of pasture, that regulating the frequency of daily livestock movements, rotation grazing to avoid overgrazing, closing off degraded pastures for several years to allow regeneration and maintaining an appropriate herd structure for a suitable time.

The study also sought to determine the influence of government support on management of rangelands in Gotu area. The study found that government have put measures to support management of local grazing land. It was revealed that development of legal frameworks in support of grazing land management, that control of access of grazing land resources and that establishment of grazing land development policies. The study found that democratization and devolution of power and natural resources and that providing a framework for participation of communities and other stakeholders in grazing land management.

Further the study sought to establish the influence of socioeconomic status of community on management of rangelands in Gotu area. The study revealed that local community's occupation

prompts their management of grazing land. The study also established that some of the reasons why local community's occupation prompts their management of grazing land were local communities manage available grazing lands to avoid traveling for the same, proper management of grazing lands ensures ideal water conservation, grazing land supports local people's livestock, which is their livelihood, by supporting livestock, grazing lands supply food to those living within and around them and grazing land preservation prevents conflicts by curbing inter-community competition for pasture.

REGRESSION ANALYSIS

In this study, a multiple regression analysis was conducted to test the influence among predictor variables. The research used statistical package for social sciences (SPSS V 21.0) to code, enter and compute the measurements of the multiple regressions. The model summary was presented in the Table 1.

Table 1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.818	0.670	0.649	1.911

The study used coefficient of determination to evaluate the model fit. The adjusted R^2 , also called the coefficient of multiple determinations, is the percent of the variance in the dependent explained uniquely or jointly by the independent variables. The model had an average adjusted coefficient of determination (R^2) of 0.649 and which implied that 64.9% of the variations in management of rangelands in Gotu area are explained by changes in size of livestock herd, community management structures, government support and socio-economic status.

The study further tested the significance of the model by use of ANOVA technique. The findings are tabulated in Table 2.

Table 2: Analysis of Variance (ANOVA)

Model	Sum of Squares	Df	Mean Square	F	Sign.
Regression	488.713	4	122.178	31.923	.000
1 Residual	241.121	63	3.827		
Total	729.834	67			

From the ANOVA statics, the study established the regression model had a significance level of 0.00% which is an indication that the data was ideal for making a conclusion on the population parameters as the value of significance (p-value) was less than 5%. The calculated value was greater than the critical value ($31.923 > 2.5087$) an indication that size of livestock herd, community management structures, government support and socio-economic status all have a significant effect on management of rangelands in Gotu area. The significance value was less than 0.05 indicating that the model was significant.

In addition, the study used the coefficient table to determine the study model. The findings are presented in the Table 3.

Table 3: Regression Coefficients

	Un standardized Coefficients		Standardized Coefficients	t	Sig
	B	Std. Error	Beta		
(Constant)	0.986	0.123		8.016	.000
Size of livestock herd	0.813	0.387	0.717	2.101	.037
Community management structures	0.767	0.236	0.681	3.250	.001
Government support	0.598	0.219	0.503	2.731	.007
Socio economic status	0.789	0.198	0.702	3.985	.000

The regression equation obtained from this outcome was:

$$Y = 0.986 + 0.813X_1 + 0.767X_2 + 0.598X_3 + 0.789X_4$$

As per the study results, it was revealed that if all independent variables were held constant at zero, then the management of rangelands in Gotu area will be 0.986. From the findings the study revealed that if Size of livestock herd increases by one unit, then management of rangelands in Gotu area would increase by 0.813. This variable was significant since $p=0.037$ is less than 0.05.

The study further revealed that if community management structures changes it would lead to 0.767 change in management of rangelands in Gotu area. The variable was significant since $p\text{-value}=0.001 < 0.05$. Moreover, the study showed that if all other variables are held constant, variation in government support variates management of rangelands in Gotu area by 0.598. This variable was significant since $p=0.007$ was less than 0.05. Finally, the study revealed that variation in socio-economic status would change the management of rangelands in Gotu area by 0.789. This variable was significant since $p\text{-value}=0.000$ was less than 0.05.

Generally, size of livestock herd had the greatest influence on management of rangelands in Gotu area followed by community management structures then socio economic status while had the government support then least effect on the management of rangelands in Gotu area. All the variables were significant since $p\text{-values}$ were less than 0.05.

CONCLUSIONS

The management of rangelands in Gotu area is significantly affected by study sought to establish size of livestock herd. The size of livestock has been indicated to motivate conservation of the grazing land. This is because large herds of livestock knock down dead plants making them decay more quickly and fertilize the soil and ensure healthy grazing lands. The improvement of degraded grazing land means more pasture for more livestock where long-term productivity for the increasing herds of livestock is guaranteed.

The community management structures were concluded to significantly affect management of rangelands in Gotu area. In this case, the local communities frequently engage in any grazing land conservation activities. These conservation activities include monitoring livestock physical characteristics to evaluate the quantity of pasture, regulating the frequency of daily livestock movements, rotation grazing to avoid overgrazing and closing off degraded pastures for several years to allow regeneration and maintaining an appropriate herd structure for a suitable time.

The study concluded government support influence management of rangelands in Gotu area positively. In Gotu area, the government have put measures to support management of local grazing land. These measures include development of legal frameworks in support of grazing land management, control of access of grazing land resources and establishment of grazing land development policies and democratization and devolution of power and natural resources.

The socioeconomic status of community was concluded to significantly influence the management of rangelands in Gotu area. The local community's occupation prompts their management of grazing land. This is because as a result of local communities manage available grazing lands to avoid traveling for the same, proper management of grazing lands ensures ideal water conservation, grazing land supports local people's livestock, which is their livelihood and grazing land preservation prevents conflicts by curbing inter-community competition for pasture.

RECOMMENDATIONS

The study recommends use of local land classification systems to identify key land resources and assign appropriate use in addition to incorporation of "traditional" authorities into formal management committees. In the light of pastoral institutional problems, a participatory approach involving local communities is recommended in determining the best opportunities and options available for the management of rangelands.

There is a need to strengthen the management capacity of rangelands through measures that enhance pastoralists' control over natural resources. Water development for production (surface water harvesting for small scale crop irrigation and livestock) and domestic use and diversion of some water would not only avail water for Gotu area but also save downstream communities from floods.

There is need to build capacity and skills of people to harvest and store rain water and surface run-off. In addition a watershed management policy in rangelands is urgently needed to save green belts. There is need to increasing access to agricultural inputs especially those used in land opening and range pasture quality improvement (seeds) and livestock restocking. Build the capacity to restore soil fertility and also improve grazing lands and overall ecosystem productivity.

There is need to sensitize the communities on rangeland restoration techniques. Government through development pattern in the region needs to establish rangeland demonstration farms that

are accessible by the pastoralists. Diversification in sources of livelihoods to reduce the negative impacts of total rangeland/livestock dependence would also reduce on environmental impact

To improve rangeland management for sustainable development and improve welfare of the local communities, there is a need to increase production and productivity of rangeland through increased off-take of livestock and livestock products and increase the income of pastoralists. This would entail research and programs that enhance the understanding of the present situation with regard to the utilization of rangelands resources.

The need for land use plans is very strong in the light of multiple uses of rangelands. The rights of pastoralists over rangeland resources should be legally recognized, thus ensuring security of tenure and protection of property. There is a need that stakeholders, pastoralists in particular, take advantage of the existing state administrative machinery to become involved in the decision-making process on matters affecting rangeland resources. NGOs, government and pastoralists working together can have a positive impact on sustainable use of rangeland resources

The study recommends a practical extension approach where rangelands are utilized according to land potential such as specific enterprises based on rainfall amount, soils, minerals and vegetation types would not only provide the community decent livelihoods but also, protect rangelands from extreme impacts of climate change events. However, this should follow a detailed study of the available resources and determine the range ecosystem resilience to guide enterprise location or appropriate range use.

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