Changing Grassland Scenario in Developing Countries--Economical and Social Perspective

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ABSTRACT

Grasslands are mainly used for livestock production in developing countries although they have been facing contradictory pressures, i.e., increased demand for natural resources and animal products to cope with rising human populations. On the other, there is a need to preserve the environment and ecosystem. This paper reviewed the causes of grassland changes, the economic and social perspective of changing grasslands with more emphasis on dry lands. Different indicators were used to assess the economic (livestock production, wildlife and tourism, crop production, ecosystem services) and social (traditional institutions, mobility, land tenure and grazing systems) perspectives of changing grassland. The major causes of grassland change/degradation are natural and human induced factors. Compared to the past, there is an increased market orientation of the communities and increased livelihood diversification. A decline in livestock productivity and mobility, emergence of different wealth classes, weakening of the traditional institutions and shifts from communal to individual landholdings are some of the changes observed. The negative economic and social perspectives regarding mobile livestock production are changing drastically. In the conclusion part, potential research activities are outlined.

Key words: Ecosystems services, Land tenure, Mobility, Pastoralism, Social institutions, Wildlife

Introduction

About 52.50 million km^2 of grasslands are found globally, of which, 28, 23, 20 and 19% are found in semiarid, humid, cold and arid regions, respectively. Grasslands (figure 1, source: Wilkes *et al*., 2012) are found in every region of the world. Sub-Saharan Africa (SSA) and Asia have the largest total area in grasslands, 14.5 and 8.9 million km^2, respectively (White *et al*., 2000; ADB, 2014). Of the 28 top countries based on the proportion of the area occupied by native grasslands, 23 are found in SSA, mostly in dry lands. Extensive mobile livestock grazing on communally owned land and extensive grazing on private land are undertaken from the dry lands of Africa and the Arabian Peninsula to the highlands of Asia and Latin America where intensive crop cultivation is physically not possible. This paper deals with extensive grasslands, but with emphasis on dry lands which have more poor people and where the rainfall is unreliable and the risk factor high. The grasslands also vary widely in production, soil types, grazing systems, cultures and practical problems associated with production often depend on their method of ownership and management (Mortimore, 2009). For instance, the herbaceous biomass data collected for 12 years in the Sahel revealed high variability in terms of production (Haan *et al*., 2014). Thus, research and development options cannot be assumed to be uniform. The grasslands are used for livestock production contributing to the livelihoods of more than 1 billion people mostly in developing countries (Mortimore, 2009). For instance, about 300

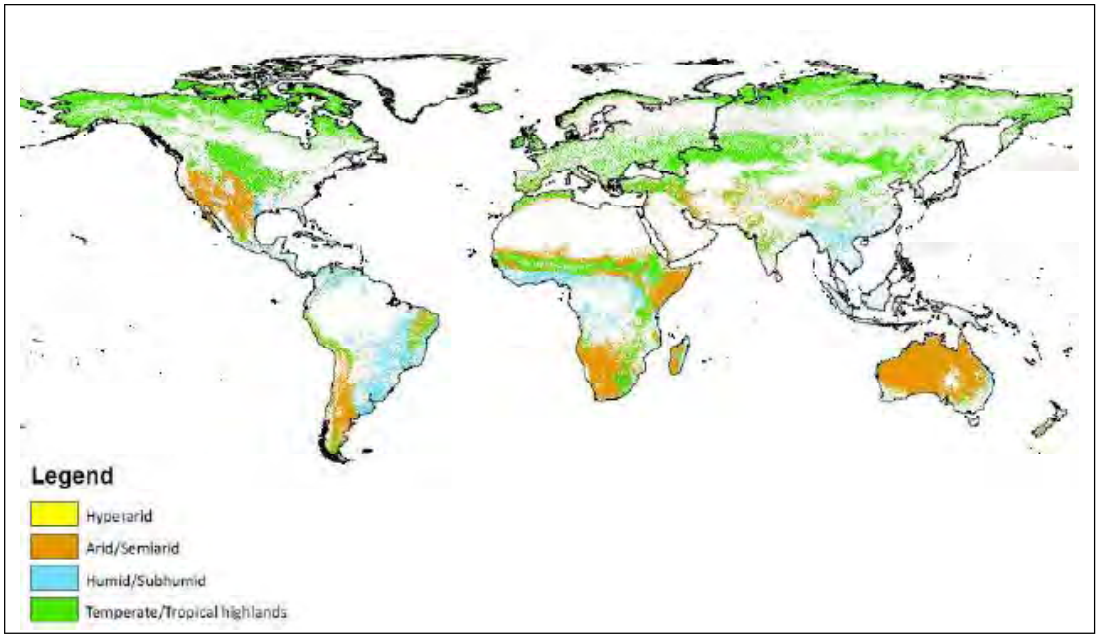

Fig. 1. Global extent of grasslands[1]

million people are located in SSA; about 60% of these depend on livestock for some part of their livelihood. Of the 50 million pastoralists in SSA, about 70 % are poor (Haan *et al*., 2014). In addition to securing livelihoods, grasslands in developing countries provide multiple goods and services of great economic, social, cultural and biological values locally, nationally and globally (Mortimore, 2009). Nevertheless, grasslands have been facing contradictory pressures, i.e., increased demand for natural resources and animal products to cope with rising human populations. Thus, their degradation and desertification have raised concerns globally. On the other, there is a need to preserve the environment and ecosystem. In addition to introduction, the causes of changing grasslands, economic and social perspectives of the change are described in the paper. The conclusion part highlights potential research activities.

Causes of changes in dry land grasslands

The causes of grassland changes are natural and human induced with overlap between the two. Among the natural causes are moisture stress, recurrent drought, climate change (human induced also), invasion by insect pests, volcanic activity, fires etc. Drought is a common phenomenon globally. For instance, droughts have occurred with greater frequency in the 1960s, 1970s, 1980s, 1990s and 2000s in SSA. It resulted in widespread disruptions of food supply and emigration owing to loss of livestock and other factors (Beruk, 2008). Global climate change is also raising new challenges where the livelihoods of pastoralists have become increasingly vulnerable (Wang *et al*., 2013). Changes in forage yield, quality, distribution and incidence of animal and plant diseases is becoming visible (Holechek *et al*., 2011).

Human population is estimated to be 9.15 billion globally with SSA to grow to 2 billion by 2050 and most of the increase will be in developing countries (Holechek *et al.,* 2011). Member states of the Intergovernmental Authority on Development (IGAD) have significant populations with around 17% of the total population in grassland-based production systems (Flintan *et al*., 2013). The same is also true for 40% of the population in Mongolia (ADB, 2014). Thus, land use changes indicating increasing size of crop land because of the expansion of sedentary agriculture and agricultural projects and declining grassland size is documented (Nkonya *et al*., 2013). Increased demand for livestock products is evident in developing countries owing to rapid population growth, urbanization, income growth and the increased production is also associated with increase in animal numbers (Thornton, 2010). Degradation of grasslands resulting from unsustainable livestock grazing is often a consequence of complex interactions between natural and man induced factors. In addition, in many developing countries, policies have favored crop production often ignoring the numerous goods and services in the dry lands. Although positive changes are observed in policies and their facilitation (e.g., SSA), their full implementation has yet to be achieved (Haan *et al*., 2014). Conflicts are also degrading the grassland ecosystems. Some of the ecological consequences of grassland degradation are: (1) reduction/lose in grassland vegetation, productivity, biodiversity, soil and etc. Estimates of more than 70% water loss to evaporation have been noted on bare ground (Donovan, 2007) an unaffordable loss at a time of increasing drought risk; (2) decline in livestock and wildlife productivity; (3) deforestation, bush encroachment and invasive alien species. The latter are the second greatest cause of biodiversity loss after habitat alteration (IGAD, 2007).

Economic perspective: The indicators for changing economic perspectives are based on livestock production, ecosystem services, wildlife and tourism and crop production. In pastoral areas, the subsistent livestock production has been under debate since 1960s. Pastoralism was considered inherently irrational, largely or solely responsible for poverty and degradation of the land (Hardin, 1968). Contrary to these assumptions, with regard to herd productivity, comparative studies of ranch and pastoral herd output in SSA (Breman and de Wit, 1983) demonstrated that pastoral livestock production either equals or exceeds the productivity per unit of land area of commercial ranching in comparable ecological environment. The SSA has about 240 million heads of cattle, 220 million sheep, and 219 million goats (FAOSTAT, 2005) and pastoral and agro-pastoral area account for a third of the cattle and half the small ruminants, all the camels, provides 60% of the beef and veal, 40% of the small ruminant meat and 70% of the milk as a whole (Rass, 2006).Mongolia has 40 million head of livestock (ADB, 2014). The six major grassland areas of China and Argentina (privately owned land) have 57,552.6 and 28,892 sheep units of livestock in thousands where 1 adult cattle = 5 sheep (Li *et al*., 2014). Commercial farms in South Africa have higher number (thousands) of beef cattle (7868) and sheep (21,561) than the small scale and communal areas (beef cattle = 5733; sheep = 3046) while the number of meat goats is higher in the latter (4268) than in the former (1730) (Meissner *et al*., 2013).

The subsistent pastoralists have traditionally used different resource management strategies to ensure their survival (milk based diet, mobility, mixed or unmixed

herds with high proportion of breeding females, use of dry season grazing reserves, maximizing stock numbers, herd splitting, social system of stock loans and re-distribution).Indigenous breeds of cattle, camels, horses, sheep, goats and others dominate with low yields. Although the sale of live animals is not the main aim of the traditional system, it is the pri-mary source of cash income. In addition, livestock and livestock products are the source of food, are essential to ensure against vulnerability, contributes to Gross Domestic Product (GDP) and job creation (Kamuanga *et al.*, 2008). Livestock contribute 70% of the total agricultural GDP in Mauritania, 8.5% of total GDP in Uganda, lowland livestock ranks second in foreign currency generation in Ethiopia and pastoral livestock in Kenya accounts for 800 million USD per year. It contributes substantially to the economy of Mali and Chad. The output values of the grassland livestock sector in the six pasture regions of China accounted for 6.3% of the overall livestock industry in the country and in Mongolia livestock generates over a fifth of the GDP (ADB, 2014). The gross value of livestock products in South Africa increased by 185% from 1995/2000 to 2006/2010 (Meissner *et al*., 2013) although low profits from domestic stock has led to increased game farming and ecotourism (Palmer and Ainslie, 2005).

There is an increased market orientation in pastoral and agro-pastoral areas as falling per capita herd wealth encourages the exchange of protein for calories/ cereals (Kamuanga *et al*., 2008; Akililu *et al*., 2013). Communities are constantly modernizing as they follow livestock market prices on cell phones, drive motorbikes, and establish self-managed or co-managed markets. Thus, livestock marketing is an economic activity creating stronger urban-rural socio-economic linkages and cuts across different livelihood groups in SSA. Milk that was once available for household consumption may be either sold to near towns or left for consumption by young animals for growth. The falling per capita herd wealth has also created different wealth classes (rich, medium and poor) (Morton and Kerven, 2013). There is a decline in livestock productivity, change in species composition depending on vegetation and degradation of resource management strategies. Thus, livestock alone cannot support their livelihood. Income/livelihood diversification has become popular (Morton and Kerven, 2013). Generally, regarding the economic perspectives of livestock production, the lingering prejudice against mobile livestock husbandry has become outdated and un- unscientific. With improvements in livestock management, social and economic interventions, livestock production is one of the most appropriate uses of arid and semi-arid areas.

Crop production: Compared to the past, it can be said that there are no areas where crop production is not practiced in pastoral areas. A study in Rayitu district (Ethiopia) revealed about 30 years before, 94% of the respondents were totally pastoralists. Currently, only 36% are purely livestock herders, with 63% combining livestock and crop production (Abate *et al*., 2010). Cropping in many dry land areas is risky with crop failures in as many as 2 to 3 years out of 5, increasingly; it remains a popular diversification strategy, especially among poor herders in SSA, although, it is exceedingly difficult for smallholder crop producers to get an adequate return on investment to consistently lift them above the poverty level (Harris and Orr, 2012). As more dry areas are cropped, it typically exploits key resource patches that are vital to pastoral production, can hinder mobility and also

increase the conflicts between herders, farmers and wildlife (Haan *et al*., 2014). It is not always clear that the economic benefits of large scale cultivation outweigh the costs imposed on livestock production through the loss of grazing land and access to water points, although Behnke and Kerven (2012) reported the advantage of the latter than the former from their study in the Awash Valley of Ethiopia.

***Ecosystem services*:** In addition to provisioning, supporting and cultural services, grasslands provide regulating services such as climate regulation through carbon sink and source functions. Ecosystem services are mostly not remunerated (ADB, 2014) and much less attention has also been paid to the potential of incentive schemes in grasslands. Grassland soils are very significant stores of carbon with global carbon stocks estimated at about 343 Gt C and tropical savannas have greater potential to store carbon below ground than any other ecosystems (FAO, 2010).Research is undertaken in developing countries to determine the carbon sequestration (CS) potential of grasslands and other vegetation types. CS from West African grasslands revealed that per hectare amounts are low, but aggregate potential is high (Lipper *et al*., 2010). Total carbon ($tCha^{-1}$) in enclosure, prescribed fire managed grazing land, and communal grazing land in southern Ethiopia was estimated to be 300, 184.9 and 141.5, respectively (Biqila *et al*., 2015, personal communication). Total carbon storage in the biomass of the grasslands of China was 3.32 Pg C, with 56.4% contained in the grasslands of the Tibet-Qinghai plateau and 17.9% in the northern temperate grasslands (Fan *et al*., 2008).Though payments for ecosystem services (PES) may not be large, they are useful to communities as source of income. For instance, the value of maintaining biodiversity in China's grasslands has been estimated at about USD7.5 per hectare per year. The relationship between management practices and environmental services is often not well understood or easily quantified, and many schemes are based on assumptions about the flow of ecosystem services rather than payments for actual services delivered (ADB, 2014). Thus, improving the knowledge base for PES, developing mechanisms for PES, addressing issues of land tenure, linking public investments in livestock and grassland management with environmental outcomes and involving communities are essential.

***Wildlife*:** Eastern and Southern Africa is famous around the world for their wildlife and tourism because their tropical savannahs and grasslands are extremely productive with respect to the diversity and biomass of their mammal communities. Wildlife based tourism and sport hunting generates over 12 billion USD as annual income (as of 2006) in eastern and southern Africa, comprising over 85% of the total tourism income generated within SSA. Tourism largely based on wildlife and natural assets brings in annual returns of 900 million to 1.2 billion USD to Tanzania's economy, represents 13% and 9% of Kenya's and Uganda's GDP, respectively. It is a source of food in both subsistence and commercial markets across much of Africa, accounting for 30 80% of household protein consumption in Central African countries (Kirkbride and Grahn, 2008). Yet, the major problems to wildlife industry are poaching and habitat loss resulting in decline in the numbers of wildlife despite the protection given to them by the governments. The mechanism of benefit sharing to the local communities from the sector which is often minimal, mainly reliant on conservation organizations and the increasing commercial interest in securing control over the resource are also concerns (Nelson *et al*., 2015). Although these problems are not fully

solved, there are a number of examples of benefit sharing from national parks to the surrounding communities. Pastoralists have also initiated conservation-related businesses like investment in tourism ventures, community-run lodges and others (e.g., Okello *et al*., 20112).Compared to the previous concept of strict conservation, the economic perspective for wildlife is encouraging and pastoralism is a more favorable land-use system for wildlife than agriculture although pastoral and grasslands are heterogeneous. Given proper policies and facilitating conditions, it is possible for livestock and wildlife to co-exist.

Social perspectives

Traditional institutions, mobility, land tenure and grazing systems are used as indicators of the social perspectives of change. Hardin (1968) reported decisions by pastoralists are motivated by tradition, rather than scientific knowledge. Studies thereafter have revealed the existence of complex social mechanisms and ecologically based management strategies which regulate the use and distribution of resources which are discussed below.

***Local institutions*:** Flexible property boundaries, reciprocal use of pastures, and underlying social networks allowed pastoral herders to use pastures efficiently (Mwangi, 2007). These traditional institutions/formal and informal regulations have evolved over centuries and were well suited to the biophysical characteristics of the area. Changes are observed although the extent and types of changes vary between regions, among countries and even with different communities in a given locality. In most cases, customary political and management systems are becoming weaker with increasing lack of clarity in the mandates of formal and traditional systems leading to overlap and competing conflict-resolution outcomes (Mwangi, 2007; Haan *et al*., 2014). The strong social cohesion and hierarchical structure within certain communities is eroding and the archaic lineage model is impaired. Nowadays, local conflicts can escalate to a more violent and regional conflict as was seen in the Sahel (Haan *et al*., 2014). Despite this, though much work is still needed, as compared to the past, there are improvements in involvement of the local communities in local government processes, ensuring adequate social services, improvement in education, health, improved communication facilities and change in gender roles.

***Mobility*:** In the semiarid and arid grasslands of the world, such as Africa and Inner Asia (i.e., Southern Russia, Mongolia, and Northern China), seasonal and inter-annual migrations used to be the management strategies of herders to live in the highly variable climate with added purposes of accessing services (e.g., market), avoidance of conflicts and seasonal diseases (Mwangi, 2007; Wang *et al*., 2013). Rather than manipulating herd numbers in response to climatic variability, as would a rancher operating in the enclosed areas, mobility is used by pastoralists as a means to adjust local imbalances in stock numbers and to make use of the seasonal availability of pasture in production dynamics, forage quality and water use. However, mobility has been a source of strong debate and there is a decrease in mobility in the traditional grazing systems of Africa and Inner Asia (Mwangi, 2007; Wang *et al*., 2013). Wang *et al*.(2013) argued that the subsequent sedentary grazing with substantial external inputs has increased the cost of livestock production in Mongolian grasslands. As a result, the livelihoods of herders in Africa and Inner Asia have become more vulnerable to climate change. If policies are to support the

biodiversity in the grasslands, pastoral mobility needs to be enabled. The introduction of pastoral codes in West Africa has been a positive development, although technocratic and poorly or incompletely implemented (Haan *et al*., 2014). Support for mobility in SSA involves consideration by governments and donors the implications for the mobile livestock production system of investments in cultivation, especially irrigated cultivation, agreed land use planning that include conflict management components and strengthening market trekking routes.

Land Tenure and grazing system: Grasslands are privately owned (e.g., Sothern America, commercial farms in South Africa) while in SSA they are generally either under government control and have open access, are private lands, or are communal property resources controlled by specific communities (FAO, 2005).In China, grasslands are stated owned with grazing rights given to individuals and China has made huge investments in terms of grassland infrastructural development, ecological restoration and herders' social security (Li *et al*., 2014). In Mongolia, pastures are managed under a combination of customary rights and formal-use rights (Li and Li, 2012).Pastoralists have developed elaborated land-use management strategies like wet and dry seasons grazing, use of fire, sophisticated mechanisms of negotiating exclusion and enforcement. Due to seasonal variations, the risk of overgrazing is short. With declining management systems, the condition of the vegetation and soil has declined. In many pastoral areas, there are shifts in land tenure policy from communal to individual landholdings (privatizing and intensifying them) coupled with high in-migration rates. The established enclosures (eastern Africa) mainly private have a higher biomass of grass than communal grazing land(Herlocker, 1999).There is increased bush encroachment in some localities and over exploitation of woody vegetation in other localities. In Mongolia, about 75% of pastureland is overgrazed and overstocked with livestock which, along with climate change, causes significant degeneration of pasturelands (ADB, 2014). Seventy percent of the grasslands in China are still moderately or heavily degraded (Li *et al*., 2014). In South Africa, grasslands and savannas face increasing risk of transformation into pastures, farmland and timber plantations (Leisher *et al*., 2011) though there are improvements in pasture condition (Meissner *et al*., 2013).Thus, unstable relationship between animal numbers and feed availability in drought-prone areas is a critical challenge (ILRI, 2002).

Conclusions

It is clear that the grasslands in dry lands are degrading mainly because of anthropogenic reasons. Thus, increasing the inclusion of communities in national policy debates, strengthening institutions of collective action and communication infrastructures, improvement in the level of education of the communities', capacity development and knowledge management and sharingare essential. Potential research areas include (1) Reviewing and documenting the extent of grasslands, how they are managed and used, extent of degradation, grassland rehabilitation/improvement practices and potential for development(2) Scaling up suitable livestock, wildlife and rangeland technologies (3) Developing simple methods of rehabilitating degraded grasslands, control of bush encroachment and invasive plants(4) Study on ways of minimizing the detrimental impact of livestock feed supply and demand imbalances including devising policy(5) Strengthening research in ecosystem goods

and services, generating more data to better understand the sequestration potential, and developing appropriate mechanism of payment for ecosystem service (6) livestock marketing system analyses (7) Determining the ecological and socio-economic impacts of conflicts, drought and climate change (8) Study on how to balance the multiple uses of goods and services in grasslands(8) Socio-economic and ecological analyses of the different interventions to be undertaken in grasslands.

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