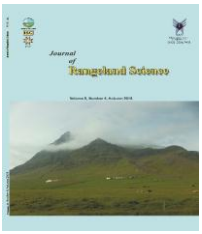
Contents available at ISC and SID

Journal homepage: www.rangeland.ir



Review and Full Length Article:

A Review on Bush Encroachment Effect on Cattle Rearing in Rangelands

Shimels Ayalew[A]*, Getachew Mulualem[B]
[A]Dire Dawa University, Biology Department, P.O. Box, 1362. *(Corresponding author), Email: shimels2080@gmail.com
[B]Ethiopian Biodiversity Institute, Wildlife studies, Mekelle center, Ethiopia

Received on: 03/04/2017
Accepted on: 20/12/2017

Abstract. Bush encroachment is an increase in woody plant density typically resulting in impenetrable thickets, suppressing palatable grasses and herbs. Moreover, bush encroachment is a globally observed phenomenon. Besides, increasing the density of unpalatable shrubs and trees has reduced the carrying capacity and threatens the sustainability of grazing animal production, especially in arid and semi-arid grasslands and savannas around the world. Bush encroachment is a serious environmental and economic problem. In addition, biodiversity, wildlife habitat and nutrient cycling (rates, magnitude, seasonability and spatially patterns) are affected by these changes in vegetation. Although the increases in woody plant abundance have widely noted, such elements as rates, dynamics, spatial patterns and approximation have not been well documented. However, land use practices such as increased grazing pressure and decreased fire frequency have been associated with shifts from grass to woody plant domination. The pastoralists have been using the traditional grazing management in order to cope up with the relatively arid conditions of the environment, prevent from overgrazing and ensure the sustainability of resource base.

Key words: Bush encroachment, Rangeland, Cattle raring, Palatable grasses, Pastoralists, Biodiversity, Woody species.

Introduction

Bush encroachment describes the transition from grass-dominated vegetation to a woody species dominated one (Dougill *et al*., 1999). Although bush encroachment is a globally observed phenomenon (Van Auken, 2000), it has been documented for arid and semi-arid rangelands much more frequently than temperate regions (Archer *et al*., 2001). It can be described as an increase in biomass and abundance of woody species and the suppression of perennial grasses and herbs (Ward, 2005). Through gradual process, the vegetation structure of arid grassland habitats around the world has changed dramatically; grass cover has declined and the density of woody shrubs has increased (Valone and Thornhill, 2001). Characteristically, bush encroachment leads to an increase in density of woody plants often unpalatable to wildlife and domestic livestock (Wiegand *et al*., 2006).

In temperate and tropical regions, rangelands contain contrasting life forms, grasses, forbs and woody species, which have a major socio-economic importance (Scholes and Archer, 1997). When the density of bush species dominates rangelands, it affects the carrying capacity due to its thorny species and as a result, the economic value of rangelands (Mugasi *et al*., 2000). Moreover, plant and animal diversities are negatively affected through a decrease in vegetation structural alteration (Meik *et al*., 2002). This leads to an overall loss of ecosystem functioning. Because trees and shrubs affect the spatial distribution and cycling of nutrients by altering soil structure, microbial biomass, soil moisture, and microclimate and by concentrating organic matter beneath their canopies (Hibbard *et al*., 2000).

A large and growing proportion of the world's human population depends on savannas like rangelands for their livestock (Scholes and Archer, 1997). In general, pastoralists depend on natural feed resources available in different rangeland vegetation types (open grasslands, open savannas) to feed their livestock (Amaha, 2006). However, the ecological and economic functions of rangelands are threatened by shrub encroachment (Ward, 2005; Wiegand *et al*., 2005). Thus, rangeland degradation causes food insecurities for the pastoralists and forces them to migrate to better feed resource areas for grazing (Amaha, 2006). Furthermore, an increase in tree cover leads to the reduced productivity and profitability of rangelands (Mugasi *et al*., 2000). Therefore, it endangers livestock production and challenging the sustainability of the pastoral system (Gemedo Della *et al*., 2006).

The reasons for the increased abundance of woody plants in any vegetation type are diverse and complex (Van Auken, 2000). However, bush encroachment has been linked to ecosystem disturbances such as fire, overgrazing (Sheuyange *et al*., 2005) and soil degradation (Dougill and Cox, 2007). For instance, the driving factors that trigger bush encroachment are heavy grazing and fire suppression (Archer, 2010; Ward, 2005).

Rangeland Biodiversity

Biological diversity [biodiversity] means the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes; this includes diversity within species, between species, and of ecosystems (UNCED, 1992). Biodiversity is a short term meaning the totality of life on earth, including the variability within a given species, population and the variety of ecosystems across a geographic area. An ecosystem is a collection of living organisms with the physical and chemical environment with which they interact to form food webs and food chains. Flora and fauna diversity depends on climate, altitude, soil and the presence of other species (Khavhagali, 2010). Rangelands vary in all their physical, biological,

climatic and human activity dimensions, but useful generalization rangelands are wild grasslands in which grasses are not artificially seeded pasture and are managed as permanent pastures. They are characterized by high temperatures, low and highly variable rainfall regimes, low vegetation cover density and fragile soil. The main economic activity is pastoralism. In East Africa, pastoralism and wildlife in the form of game reserves and national parks mainly for the tourism industry go hand in hand (Mugerwa, 2001).

These rangelands provide multiple uses for society including wildlife habitat for a variety of game and nongame animals, high quality water, clean air and open spaces for industries, municipalities, agricultural uses, recreational activities (hunting, fishing, hiking) and the foundation for low impact, renewable food and fiber production systems through the livestock grazing industry (James *et al*., 2003). Rangelands also provide a variety of other important products, services and values. These includes habitat, biodiversity, products such as charcoal, gums and resins, and honey and traditional medicinal uses, water production and aesthetic values (Friedel *et al*., 2000).

Many grasslands and rangelands have an important woody plant component. In temperate and subtropical regions, shrubs often provide the woody component of grasslands (Sala *et al*., 1996). Rangelands are the semi-arid regions of the world that are too dry for reliable crop cultivation used for livestock production of one form. They span the tropics and temperate zones varying considerably in their vegetation and native fauna. However, living aside differences at the species level, the vegetation is characteristically a mixture of grasses, shrubs and trees, ranging from pure grasslands to the woodland savannas of the sub-humid tropics. Depending on the kind of rangeland, the welfare of the pastoralists is based on grazing animals (cattle and sheep), mixed feeders (browsers and grazers like camels and goat) or a combination of them (Walker and Janssen, 2002).

In many countries, pastoral rangelands are the primary and only source on which both wild and domesticated herbivores depend on. As the human population has increased, pastures have been converted into cropland resulting in an overgrazing of the remaining grassland (Carlier *et al*., 2009). The Asian and African rangelands have been occupied by humans and domesticated livestock for hundreds of years. The pattern of use differed under the native fauna with nomadism (emulating the seasonal migrations of native ungulates) as the characteristic of drier regions, and low populations of livestock being maintained in others (Walker and Janssen, 2002). According to James *et al*. (2003), the majority of rangeland ecosystems are located in vegetation biomes such as grasslands, shrub lands, savannas and deserts. Furthermore, the desert and semi-desert ecosystems harbor valuable animal and plant species many of which are endemic (Abiyot and Getachew, 2006).

Bush encroachment and associated rangeland degradation

The term ‘rangeland degradation’ refers to describe the vegetation changes that have taken place as a source of three interrelated phenomena: desertification, woody plant encroachment and invasion of non-native species (Wilcox, 2007). These three phenomena have altered most rangelands having arid, semi-arid, and sub-humid climates and together are a major component of global change that has important implications for the water cycle. On the other hand, degradation is defined as a decrease in plant species diversity, plant height, vegetation cover and plant productivity. Recently, degradation has also come to mean deterioration in ecosystem services and functions such as deceased water and soil conservation, recreation values, and carbon balance (Han *et al*., 2008).

Bush encroachment affects savanna grasslands in many regions of the world (Scholes and Archer, 1997; Roques *et al*., 2001). Furthermore, related rangeland degradation causes major ecological transformation of savanna ecosystems grazed by livestock (Hudak, 1999; Roques *et al*., 2001). For instance, rangelands constitute an important land use in Botswana livestock production as the most significant aspect of the agricultural economy of the country (Dregne, 2002). The invasion of pastures and grazing land by a large number of trees is generally regarded as rangeland deterioration in Botswana (Aweto and Dikinya, 2003).

Rangelands are the most extensive land area of the earth and mostly occur in dry climates. Collectively, they include the dryland biomes classified as savannas, grasslands, shrub lands, and deserts, which constitute about 51% of the earth's total land area (Asner *et al*., 2004). Thus, shifts in the amount of woody cover as a result of climatic changes, fire, herbivory, and human agency have the potential to exert strong impacts on ecosystem function in savannas (Holdo *et al*., 2009). Savannas comprise 40% of the terrestrial land mass and sustain a significant fraction of the population of many developing countries (Holdo *et al*., 2009); so, these changes may have deep impacts on human welfare globally.

A less well known, more subtle and widespread form of rangeland degradation is encroachment by generally unpalatable trees and shrubs at the expense of palatable grasses over a time span of several decades (Hudak, 1999). In addition, rangeland degradation causes major ecological transformation of savanna ecosystems grazed by livestock (Roques *et al*., 2001). In general, rangeland degradation implies a reduction in rank or status, which includes a loss of topsoil, a change in a simple flora /fauna composition or a transition from one organic form to a lower organic one, and continuous reduction of productivity biomass of the ecosystem. Normally, a lower biological diversity is supposed to occur in a degraded rangeland (Tesfaye *et al*., 2010).

Bush encroachment in rangelands

Bush encroachment is an increase in density of woody plants often unpalatable to wildlife and domestic livestock (Ward, 2005; Wiegand *et al*., 2006). Moreover, rangeland ecosystems in the world are threatened by increasing densities of woody plants (Scholes and Archer, 1997; Brown and Archer, 1999; Van Auken, 2000; Archer *et al*., 2001; Roques *et al*., 2001; Wiegand *et al*., 2005). The increase in density to extreme cases leads to ranch failure and apparently irreversible range degradation (Tobler *et al*., 2003). Besides, woody species encroachment into grassland dominated areas reduces grazing carrying capacity (Wiegand *et al*., 2005).

More importantly, rangelands contain a large proportion of the world's human population, livestock and wild ungulate herbivores (Scholes and Archer, 1997; Archer *et al*., 2001). Nevertheless, woody encroachment has occurred in savannas all over the world and can have profound negative consequences for the economic viability of affected rangelands (Scholes and Archer, 1997; Tobler *et al*., 2003). For instance, shrub encroachment into arid and semi-arid grasslands in the southwestern United States is one of concerns because increased shrub cover leads to declines in species diversity, water availability, grazing capacity, and soil organic matter (Laliberte *et al*., 2004).

Human population growth and widespread Anglo-European settlement during the 18th and 19th centuries have influenced the balance of grass-woody plant interactions worldwide (Archer *et al*., 2001). Due to this, woody plant encroachment has been widespread in grassland and savanna ecosystems of North and South America, Australia, Africa, and Southeast Asia over the past century (Archer *et al*., 2001). Because of its direct effects on livestock production,

encroachment of woody vegetation into grasslands has been one of the most important problems facing the ranching industry in the western United States and grazers and pastoralists in arid and semiarid regions (Archer *et al*., 2001).

Bush encroachment in savanna ecosystems is a worldwide phenomenon that has created a serious problem for the pastoral industry (Wiegand *et al*., 2005; Van Auken, 2000). Especially, bush encroachment is a threat to livestock management in tropical savannas worldwide (Scholes and Archer, 1997; Roques *et al*., 2001). The negative effect of trees on grasses may be resulted from rainfall interception, litter accumulation, shading, root competition or a combination of these factors; the effect depends on the leaf areas, canopy architecture, and rooting patterns of the tree (Archer *et al*., 2001).

Causes of bush encroachment

The proximate causes for woody plant encroachment are still poorly understood (Ward, 2005; Archer *et al., 1995*; Van Auken, 2000). However, changes in land use practices such as overgrazing and climate changes (Brown *et al*., 1997) as well as fire suppression (Van Auken, 2000; Sheuyange *et al*., 2005) because seedlings of all shrub species are fire sensitive (Archer *et al.,* 1995) and reduction in the population of large browsers due to poaching greatly contributed to an increase in thicket encroachment (Archer *et al.,* 1995).

The suppression of fire, injudicious stocking rates, poor rangeland management practices, weakening of traditional rangeland and water management strategies, frequent drought and artificial water points are also regarded as the major causes of bush encroachment (Gemedo Dalle *et al*., 2006). For instance, the ban on fire in the 1970s might also have facilitated the expansion of bush encroachment in Borana rangelands of Ethiopia (Gemedo Dalle *et al*., 2006; Ayana, 2007). However, according to Dougill *et al*. (1999) and Walker (1997), the causes of bush encroachment are elaborated upon the background of two important models:

Walter's Two-layer Model maintains that if the grass layer is over utilized, it loses its competitive advantage and can no longer use water and nutrients effectively. This results in a higher water and infiltration rate into the subsoil. Such a scenario will benefit trees and bushes and allow them to dominate.

In this model, the ecological balance between bush and grass production is determined by the relative availability of soil water and key nutrients (principally nitrogen and phosphorous) in different rooting zones in the soil profile. Ecologically, grasses out-compete bush species for water and nutrients in the topsoil (0-50 cm depth) while bush species have the competitive advantage in the subsoil below 50 cm (Dougill *et al*., 1999).

According to the two-layer model, the cattle grazing affects the bush-grass ratio by suppressing grass growth, and therefore topsoil plant water uptake, promoting soil water movement into the subsoil. At the same time, the increased mineralization of organic nitrogen inputs of cattle dung more rapidly decomposed than residual plant litter enhances leaching of this vital plant nutrient into the subsoil (Fig. 1). Consequently, the two-layer model predicts that areas of intensive grazing experience significant increase in moisture content and "plant available " inorganic nutrient concentrations in their subsoil layers; bush encroachment is the ecological consequences (Dougill *et al*., 1999).

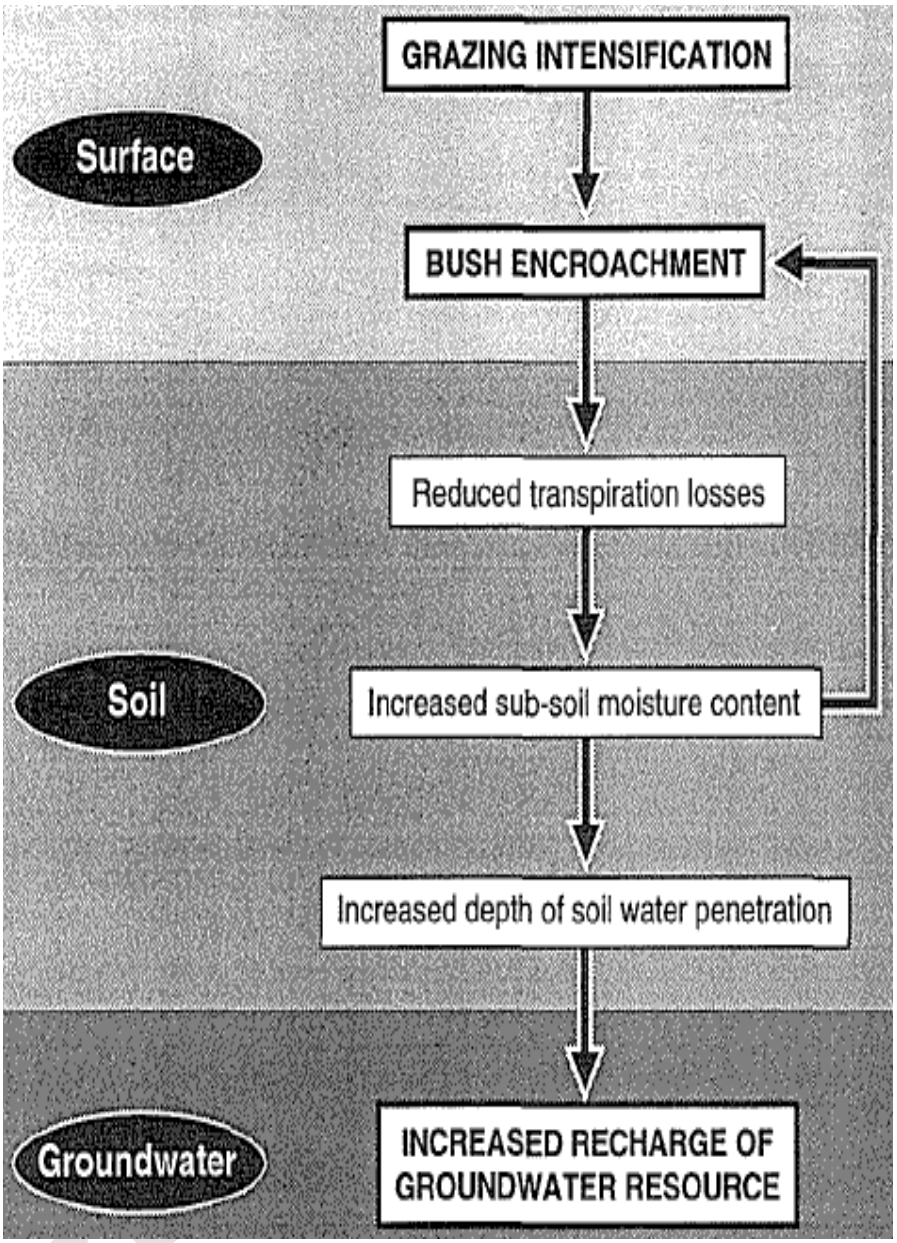


Fig. 1. The links between land use changes and the key environmental systems in the Kalahari ecosystem displaying the important long-term hydrological and ecological impact assigned to grazing intensification by this "two-layer model of environmental change" (Walker & Noy –Meir, 1982 cited in Dougill *et al*., 1999).

The State-and-Transition Model recognizes the dynamic nature of savanna ecosystems. Savannas are event-driven where rainfall and its variability plays a more important role in vegetation growth (and composition) than the intensity of grazing. Therefore, it implies that bush encroachment is not a permanent phenomenon and a savanna could be changed to its grass-dominated state by favorable management or environmental conditions (Lopez *et al*., 2011).

Concerning determinants involved in the dynamics of rangelands

The effects of woody plants on herbaceous species can be positive, neutral or negative depending upon the characteristics of the woody and herbaceous growth-forms, ecophysiological features, photosynthetic pathway (C_3 versus C_4), habitant, water and nutrient requirements (Scholes and Archer, 1997). Savanna ecosystems characterized by a continuous layer of grass intermixed with a discontinuous layer of trees and shrubs

are among the most striking vegetation types where contrasting plant life forms co-dominate (Scholes and Archer, 1997). However, a complex set of factors as determinants influences the balance between trees and grasses in savanna ecosystems. The principal determinants of savanna structure and functioning are soil moisture, soil nutrients, herbivory and fire (Meyer, 2006).

The impact of bush encroachment to cattle production

Savannas cover more than one-fifth the world's land surface and harbor most of the world's rangelands, livestock and large mammal diversity. Savanna trees can have a variety of effects on grasses with consequences for the wild and domestic herbivores that depend on them (Riginos *et al*., 2009). Woody or bush encroachment can have profound negative consequences for native fauna (Scholes and Archer, 1997) and rangeland productivity (Tobler *et al*., 2003).

In African savannas, an intense cattle grazing is commonly associated with an increase in woody vegetation (Roques *et al*., 2001; Riginos and Young, 2007). Bush encroachment is one of most extensive deteriorations in Namibia and an urgent problem for rangeland productivity (Meik *et al*., 2002; Schröter *et al*., 2009). Furthermore, there is considerable concern in South Africa over the impact of bush encroachment on rangeland productivity (Lechmere-Oertel *et al*., 2005; Piennar and Smit, 2010). For instance, bush encroachment affects the agricultural productivity and biodiversity of 10-20 million ha of South Africa (Ward, 2005) and Uganda (Mugasi *et al*., 2000). Similarly, shrub encroachment has been documented from many semi-arid savanna rangelands in southern Africa (Roques *et al*., 2001). According to more recent assessments, bush encroachment has rendered 1.1 million ha of South African savanna unusable, threatens another 27 million ha, and has reduced the grazing capacity throughout the region up to 50% (Grossman and Gander, 1989 cited in Hudak, 1999).

The relative abundance of trees and grasses can affect important aspects of ecosystem function including hydrology, carbon and nitrogen shortage and cycling, and grass and herbivore productivity (Scholes and Archer, 1997). Therefore, the condition of the ecosystem has an immediate effect on the economic system and bush encroachment severely restricts profitability of cattle farming (Mugasi *et al*., 2000). This phenomenon jeopardizes grasslands biodiversity and threatens the sustainability of pastoral, subsistence and commercial livestock grazing (Asner *et al*., 2004). As such, it may adversely impact 20% of world's population (Archer *et al*., 2001). Furthermore, woody encroachment may lead to the displacement of wildlife species that depend on open grasslands, decrease species diversity, disrupt natural disturbance regimes, and reduce amount of grazing lands available for livestock (Laliberte *et al*., 2004). Woody or bush encroachment can have intense negative consequences for native fauna (Scholes and Archer, 1997; Riginos *et al*., 2009) and rangeland productivity (Mugasi *et al*., 2000; Tobler *et al*., 2003; Abiyot and Getachew, 2006; Amaha, 2006).

In the Kalahari of Botswana like many other open savannas, the main ecological change following cattle based agricultural intensification is one of grass removal and bush encroachment (Dougill and Trodd, 1999). In the pastoral rangelands of Uganda, range deterioration due to shrub encroachment is identified as a major factor affecting livestock production (Mugasi *et al*., 2000) and in Zimbabwe, bush encroachment also affects livestock production (Mzezewa and Gotosa, 2009).

On the other hand, bush encroachment is one of most extensive changes in land cover in Namibia and an urgent problem

for cattle farming, rapidly reducing the productivity of the rangeland (Schroter *et al*., 2009). Additionally, in the pastoral rangelands of Uganda, range deterioration due to shrub encroachment is identified as a major factor affecting livestock production (Mugasi *et al*., 2000). Ethiopian rangelands and cattle productions are also at higher risk diminishing (Ayana *et al*., 2006; Amaha, 2006; Gemedo Dalle *et al*., 2006).

A high density of trees and shrubs can have strong negative effects on grasses, rangeland productivity, and wild herbivores (Scholes and Archer, 1997). Therefore, the condition of the ecosystem has an immediate effect on the economic system and bush encroachment severely restricts profitability of cattle farming (Sweet, 1998). For instance, the economic well-being of more than two thirds of the population of Namibia directly or indirectly depends on agriculture and 65% of the national agricultural output is produced on commercial rangelands (Sweet, 1998). In addition, bush encroachment reduces the carrying capacity of savanna rangelands and is widely regarded as undesirable (Hudak and Wessman, 2001). Furthermore, bush encroachment is seen to be one of the most extensive changes in land cover and is perceived as an urgent problem for rangeland productivity (Sweet, 1998). According to Sheuyange *et al*. (2005), bush encroachment also impacts adversely biodiversity, water- use efficiency and underground water tables, thereby contributing to the process of desertification.

As woody plant cover or density increases, grass production typically declines dramatically. Encroachment of trees may further intensify grazing pressure as landholders seldom destock the response to decreases in grass production associated with increases in tree density. Because bush encroachment may lead to failure of commercial ranching systems, landowners commonly engage in extensive bush clearing (Scholes and Archer, 1997). Bush encroachment affects rangelands productivity and reduces the total biodiversity of the arid and semi-arid regions by reducing their abundance and distribution (Abiyot and Getachew, 2006). Encroachment has long been of concern to land managers in grasslands and savannas, but most research focuses on the effects of woody plants on grass production (Archer *et al*., 2001). On the whole, woody vegetation reduces grass cover through increasing competition for available water and nutrients and reducing light reaching the grass layer. In addition to competing with grasses, the noxious woody plants are commonly thorny and thicket forming and reduce the grazing capacity of the rangeland (Tesfaye *et al*., 2010).

Traditional rangeland management practices

The pastoralists in general depend on natural feed resources available in different rangeland vegetation to feed their livestock. The potential productivity of the rangelands to provide adequate feed and the availability of the desirable plant species is influenced by the erratic and adequate rainfall in pastoral areas. However, pastoralists have developed traditional grazing /browsing land use systems to mitigate feed shortages and make better use of the available feed resources (Amaha, 2006). The Borana pastoralists traditionally practiced strategic grazing management to avoid local overstocking around the scarce dry season water sources they used in different grazing areas in the dry and wet seasons; lactating cows with their calves were herded separately from dry cows, bulls and young stock (Ayana, 2002). They use their indigenous knowledge to categorize landscapes not only in terms of seasons of use, but also in terms of grazing capacity (Oba and Kotile, 2001).

Bush clearing, rangeland burning and herd diversification are mentioned as potential options to minimize the negative impact of woody plants (Gemedo Della *et al*., 2006). The use of bush or shrub clearing may be important in the management and improvement (condition and productivity) for the rangelands (Ayana, 2002). On the other hand, Borana pastoralists increasingly include camels in their herds, and a bushy environment forms a good habitat for camels'. Cattle are adversely affected by bush encroachment because they rely on grass production (Ayana, 2002). Pastoral communities usually have a detailed knowledge of their grazing lands, acquired through extensive observation and continuous herding practice (Oba and Kotile, 2001).

Studies on indigenous knowledge of rangeland management have shown that pastoralists have management strategies and own traditional ecological knowledge to classify rangelands and assess range conditions and trend (Ayana, 2002). Traditional knowledge in natural resources management and utilization has been playing important roles in improving and developing land use system. The pastoralists have been using the traditional grazing management in order to cope up with the relatively arid conditions of the environment, prevent from overgrazing and ensure the sustainability of the resource base.

Pastoralists use flexible grazing strategies. Overall, their grazing management is the result of their cumulative knowledge about resources, assessment of range condition and distribution of rainfall (Ayana, 2002; Amaha, 2006; Oba and Kaitira, 2006). For instance, Borana pastoralists in southern Ethiopia have a well-established traditional system of range and water management. Bush clearing, rangeland burning and herd diversification are mentioned as potential options to minimize the negative impact of woody plants (Oba and Kotile, 2001; Ayana, 2002; Gemedo Dalle *et al*., 2006; Ayana, 2007; Niguse Bekele, 2008).

Future perspectives

The impact of this would be far-reaching that ranges from deterioration of the rangeland biodiversity to total habitat alteration. These call for taking appropriate conservation measures without a significant delay, and in light of this, the following future perspectives are made. In the upcoming rapid expansion of human population, the following considerations should be taken to conserve and sustainably use rangeland ecosystems. Unless proper management measures are taken, bush encroachment continues invading new areas and driving out pastoralists and farmers from their localities, frustrating food and feed shortage in the encroached regions. Thus, proper management and control of bush encroachment is urgent using controlling techniques in cooperation with experts and local people.

Otherwise, threats of local biodiversity would be aggravated and local inhabitants moved away from their localities; then, habitats will lose their manifestations to the long run. Besides, tribal conflict for the remaining few grazing and farm areas which is free from bush encroachment may lead into unexpected political crisis. Furthermore, this prevents from the progress of the countries endeavors to alleviate poverty and feed their people since bush encroachment decreases the rangeland productivity and endangers biodiversity in general. Since the problem facing rangelands has emerged over many years, the solutions also require time to implement.

It is observed that encroachment of woody plants jeopardizes grassland biodiversity and threatens the sustainability of pastoral subsistence in many rangelands of the world. So, it is indispensable that degradation of

rangelands should be halted and the current condition of rangelands can be improved through rangeland rehabilitation, conservation and improved management practices. Rangeland deterioration will continue to occur unless remedial measures are taken. The conservation, preventative and remedial actions and ongoing management of rangelands should be integrated to protect biological diversity loss and maintain the ecological processes which provide the productive capacity of rangelands.

Proper management and control of bush encroachment is urgent using controlling techniques in cooperation with experts and local people. Since bush encroachment is the major threat to rangeland methods like burning and mechanical bush clearing should be employed to control the invading woody species. Charcoal production from some of the species may be worth considering. Awareness creation campaign should be conducted to acquire a shared view on the use and conservation of rangelands.

Conclusion

This paper has reviewed the evidence in support of dominance of bush encroachment in rangelands and its concomitant implications to cattle rearing. Bush encroachment can affect rangelands by suppressing and deteriorating native flora. On the other hand, the cattle production needs palatable grasses that livestock primarily depend on. Encroaching plant species negatively impact rangelands throughout the world by displacing desirable species, alerting ecological processes, reducing wildlife habitat, degrading ecosystems, and decreasing productivity. Therefore, woody plant encroachment reduces the carrying capacity for livestock in rangelands. Rangelands have typical values which encompasses the ecological foundations compulsory to sustain the livelihood of large population. Greater emphasis should be given to contemplate to rescue the livestock production that hosts huge population. Rangeland ecosystem stability should be kept among developmental goals and conservation priorities.

Local people have to be informed about the invasive nature of the bushy species with their dispersal mechanisms and should be advised on management practices to minimize its spread. A major conclusion to be drawn is that rangeland health condition is not sustainable and cattle raring is at risk. Generally, adopting all available eco-friendly eradication mechanisms can help to avoid and halt rapid invasion of new areas.

Acknowledgments

The author would like to acknowledge Dire Dawa University and Ethiopian Biodiversity Institute for providing encouragement to review on this article which supports livestock productivity at the interest of the local developmental needs. We are specifically thankful for the extensive and useful comments of the anonymous reviewers.

References

Abiyot B. and Getachew T. 2006. The prosopis Dilemma, Impacts on Dryland Biodiversity and some controlling methods. Journal of the Dryland, 1(2): 158-164.

Amaha, K. 2006. Characterization of Rangeland Resources and Dynamics of the Pastoral production systems in the Somali Region of Eastern Ethiopia. PhD Thesis, University of the Free State, South Africa.

Archer, S. 1995. Herbivore mediation of grass-woody plant interactions. Tropical grasslands 29:218-235.

Archer S. 2010. Rangeland conservation and shrub encroachment: new perspectives on an old problem. In: du Toit J T, Kock R, Deutsch J C. Wild Rangelands: Conserving Wildlife While Maintaining Livestock in Semi-arid Ecosystems. Chichester: John Wiley and Sons Ltd., 53–97.

Archer, S., Schimel, D. and Holland, E. 1995. Mechanism of shrub land expansion – land use, climate, or Co2 climatic change, 29, 91-99.

Archer, S, Boutton, T., Hibbard. K. 2001 Trees in grasslands: Biogeochemical Consequences of woody plant expansion. In: Global Biogeochemical Cycles in the Climate System, pp. 47 (Schulze, E., Harrison, S., Heimann, M., Holland, E., Lloyd, J., Prentice, I. and Schimel, D. eds.), Academic Press, San Diego, USA.

Asner, G. Elmore, A., Olander, L., Martin, R., and Harris, T. 2004. Grazing systems, Ecosystem responses, and global change. Annual Review environment and resource, 29: 261-299.

Ayana A. 2002. The effect of clearing bushes and shrubs on range condition in Borana, Ethiopia. Tropical Grasslands, 36: 69-76.

Ayana A. 2007. The Dynamics of Savanna Ecosystems and Management in Borana, Southern Ethiopia. PhD Thesis, Norwegian University of Life Science, Norway.

Ayana A., Adugna, T. and Atilaw B.. 2006. The effects of physical environment on the condition of rangelands in Borana. Tropical Grasslands, 40: 33-39.

Aweto, A. and Dikinya, O. 2003. The beneficial effects of two tree species on soil properties in a semi-arid savanna rangeland in Botswana. Land Contamination & Reclamation, 11(3): DOI 10.2462/09670513.618.

Carlier, L., Rotar. I, Vlahova. M and Vidican. R. 2009. Importance and Functions of Grassland s. Agrobotanici, 37(1): 25-30.

Dougill, A. Heathwaite, A. Thomas, D. 1998. Soil water movement and nutrient cycling in semi-arid rangeland: Vegetation Change and System Resilience. Hydrological Process, 12:443-459.

Dougill, A. and Cox, J. 2007. Land degradation in the Kalahari new analysis and alternative perspectives. Retrieved from (http://www.odi.org.uk/pdn /papers/38c.pdf) on 20/1/2011.

Dougill, A. and Trodd, N. 1999. Monitoring and modeling open savannas using multisource information: analyses of Kalahari studies. Global Ecology and Biogeography, 8: 211-221.

Dougill, A., Thomas, D. and Heathwaite, A. 1999. Environmental change in the Kalahari: Integrated Land degradation Studies for Nonequlibrium Dryland Environments. Annuals of the association of American geographers, 89(3): 420-442.

Dregne, E. 2002. Land Degradation in the Drylands: International Center for Arid and semi-arid Land Studies. Texas Tech University Lubbock, Texas, USA.

Friedel, M., Laycock, W., and Bastin , G. 2000. Assessing rangeland condition and trends. In Field and Laboratpry method for grassland and animal production research. (Eds. Mannetje, L. and Jones, R.) CAB International, UK, PP27-261.

Gemedo Dalle, Maass, B. and Isselstein, J. 2006. Encroachment of woody plants and its impact on pastoral livestock production in the Borana lowlands, southern Oromia, Ethiopia. African Journal of Ecology, 44: 237-246.

Han, J., Zhang, Y., Wang, C., Bai, W., Wang, Y., Han, G. and Li, L. 2008. Rangeland degradation and restoration management in China. The rangeland Journal, 30: 233-239.

Hibbard, K., Archer, S., Schimel, D. and Valentine, D. 2000. Biochemical changes accompanying woody plant encroachment in a subtropical savanna. Ecology, 82(7): 1999-2011.

Holdo, R., Holt, R. and Fryxell, J. 2009. Grazers, browsers, and fire influence the extent and spatial patterns of tree cover in the Serengeti. Ecological Applications, 19(1): 95-109.

Hudak, A. 1999. Rangeland Mismanagement in South Africa: Failure to Apply Ecological Knowledge. Human Ecology, 27: 55-78.

Hudak, A. and Wessman, C. 2001. Textural analysis of high resolution imagery to quantify bush encroachment in Madikwe Game Reserve, South Africa, 1955-1996.International Journal of Remote Sensing, 22(14): 2731-2740.

James, L., Young, J., Sanders, K. 2003. A New Approach to Monitoring Rangelands. Arid Land Research and Management, 17: 319-328.

Laliberte, A., Rango, A., Havstad, K., Paris, J., Beck, R., McNeely, R. and Gonzalez, A. 2004. Object-oriented image analysis for mapping shrub encroachment from 1937 to 2003 in southern New Mexico. Remote sensing of Environment, 93: 198-210.

Khavhagali, V. 2010. Poster Presentation: Importance, Threats, Status and Conservation challenges of Biodiversity in Northern Cape.

Lopez D., Cavallero M., Brizuela M. and Aguilar M. 2011. Ecosystemic structural–functional approach of the state and transition model. Applied Vegetation Science, 14: 6–16.

Meik, J., Jeo, R., Mendelson, J. and Jenks, K. 2002. Effects of bush encroachment on an assemblage of diurnal lizard species in central Namibia. Biological conservation, 106: 29-36.

Meyer, K. 2006. Cyclical succession in semi-arid savannas revealed with a spatial simulation

model. PhD Thesis, Friedrich-Schiller-University, Germany.

Mugerwa, W. 2001. Rangelands Management Policy in Uganda. A paper prepared for the International Conference on Policy and Institutional Options for the Management of Rangelands in dry Areas, Hammamet, Tunisia.

Mugasi, S., Sabiiti, E. and Tayebwa, B. 2000. The economic implication of bush encroachment on livestock farming in rangelands of Uganda. African Journal of Range & Forage Sciences, 17(1, 2&3): 64-69.

Oba, G. and Kaitira, L. 2006. Herder knowledge of landscape assessments in arid rangelands in northern Tanzania. Journal of Arid Environments, 66: 168-186.

Oba, G. and Kotile, D.G. 2001. Assessments of Landscape Level Degradation in Southern Ethiopia: pastoralists Versus Ecologists. Land Degradation and Development, 12:461-475.

Riginos, C., Grace, J., Augustine, D. and Young, T. 2009. Local versus landscape –scale effects of savanna trees on grasses. Journal of Ecology, doi: 10.1111/j.1365-2745.01563.x.

Riginos, C. and Young, T. 2007. Positive and negative effects of grass, cattle, and wild herbivores on Acacia saplings in an East African Savanna. Oecologia, doi 10.1007/s00442.

Roques, K., O'Connor, T. and Watkinson, A. 2001.Dynamics of shrub encroachment in an African savanna: relative influences of fire, herbivory, rainfall and density dependence. Journal Applied ecology, 38:268-280.

Sala, O., Lauenroth, W., Mc Naughton, S., Rusch. G. and Zhang, X. 1996. Biodiversity and Ecosystem Functioning in Grasslands: Functional Roles of Biodiversity. In: A global perspective, Pp.131 (Mooney, H., Cushman, J., Medina, E., Sala, O. and Shulze, E. eds.).

Scholes, J. and Archer, S. 1997. Tree-grass Interactions in Savannas. Annual Review of Ecology and Systematics, 28:517-544.

Sheuyange, A., Oba, G., Weladji, R., 2005. Effects of Anthropogenic Fire History on Savanna Vegetation in Northeastern Namibia. Journal of Environmental Management, 75: 189-198.

Schroter, M., Jakoby, O., Olbrich, R., Eichhorn, M. and Baurngartner, S. 2009. Remote Sensing of bush encroachment on commercial cattle farms in semi-arid rangelands in Namibia. Working Paper Series in economics, University of Luneberg, Germany.

Sweet, J. 1998. Livestock-coping with drought: Namibia- A case study. A paper prepared for the Grassland Group of the Crop and Grassland Service of FAO. Northern Regions Livestock Development Project, Tsumeb, Namibia.

Tesfaye D., Azage T., Lisanework N. and Worku T. 2010. Rangeland condition and feed resources in Metema District, North Gonder Zone, Amhara Region, Ethiopia. Working paper, Improving Productivity and Market Success of Ethiopian Farmers project (IPMS) - International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia.

Tobler, M., Cochard, R. and Edwards. 2003. The impact of cattle ranching on large-scale vegetation patterns in a coastal savanna in Tanzania. Journal of Applied Ecology, 40: 430-444.

UNCED. 1992 Convention on Biological Diversity - A global biodiversity strategy. United Nations Conference on Environment and Development (Earth Summit, Rio de Janeiro, Brazil

Valone, T. and Thornhill, D. 2001. Mosquite establishment in arid grasslands: an experimental investigation of the role of kangaroo rats. Journal of Arid Environments, 48: 281-288.

Van Auken, O. 2000. Shrub invasions in North American Semi-arid Grasslands. Annual Review of Ecological System, 31: 197-215.

Walker, S. 1997. Models of vegetation dynamics in semi-arid vegetation: application to lowland central Otago, New Zealand. New Zealand Journal of Ecology, 21(2): 129-140.

Walker, B. and Janssen, M. 2002. Rangelands, pastoralists and governments: interlinked systems of people and nature. The Royal Society, 720.

Ward, D. 2005. Do We Understand the Causes of Bush Encroachment in Africa Savannas? Africa Journal Range and Forage Science, 22: 101-105.

Wiegand, K., Ward, D. and Saltz, D. 2005. Multi-scale patterns and bush encroachment in an arid savanna with a shallow soil layer. Journal of Vegetation Science, 16: 311-320.

Wiegand, K., Saltz, D., Ward, D. 2006. A patch - dynamics approach to savanna dynamics and woody plant encroachment −Insights from an arid savanna. Evolution and Systematics, 7:229-242.

Wilcox, B. 2007. Does rangeland degradation have implications for global stream flow? Hydrological processes, DIO: 10.1002/hyp.6856.

مروری بر اثر بوته‌های غالب بر پرورش گاو در مراتع

شیملز آیلوالف*، گتاچو مولالمب
الفدانشگاه دیر داوا، گروه بیولوژی، اتیوپی *(نگارنده مسئول)، پست الکترونیک: shimels2080@gmail.com
بموسسه تنوع زیستی اتیوپی، مطالعات حیات وحش، مرکز مکل، اتیوپی

تاریخ دریافت: ۱۳۹۶/۰۱/۱۴
تاریخ پذیرش: ۱۳۹۶/۰۹/۲۹

چکیده. گونه‌های گیاهی بوته‌ای غالب در مراتع با گسترش خود باعث حذف گونه‌های خوشخوراک و مورد علاقه دام‌ها می‌شوند. گسترش و توسعه گونه‌های بوته‌ای چوبی یک پدیده جهانی است. افزایش تراکم درختان و بوته‌های غیر خوشخوراک موجب کاهش ظرفیت مرتع و ظرفیت چرای شده است. این موضوع باعث به خطر افتادن پایداری تولیدات دامی ناشی از چرا و به خصوص در گراسلندهای مناطق خشک و نیمه خشک و نیز ساواناهای موجود در دنیا شده است. توسعه و گسترش بوته‌ها مشکل جدی اقتصادی و محیط زیستی است. همچنین این موضوع باعث اثر گذاری بر تنوع زیستی و چرخه مواد غذایی (کمیت، کیفیت و الگوی پراکنش) می‌شود. از طرف دیگر افزایش فراوانی گیاهان چوبی بطور وسیعی مورد توجه قرار گرفته است، به این دلیل که برخی عناصر این گیاهان نظیر نرخ فراوانی، تحرک آنها، الگوهای مکانی پراکندگی به خوبی مورد مطالعه قرار نگرفته‌اند. با این وجود در کاربری اراضی نظیر فشار چرای زیاد و کاهش فراوانی آتش‌سوزی موجب تغییر جامعه گیاهی گندمیان به سمت غالبیت گیاهان چوبی شده است. چوپانان و گله‌داران مدیریت چرای سنتی را با توجه به شرایط خشکی محیط زیست مورد استفاده قرار داده‌اند. این کار جهت جلوگیری از چرای سنگین و اطمینان از پایداری منابع پایه برای دامها می‌باشد.

کلمات کلیدی: بوته‌های غالب، مراتع، پرورش گاو، گندمیان خوشخوراک، چوپانان، تنوع زیستی، گونه‌های چوبی