ASSESSMENT, CONTRIBUTIONS AND MANAGEMENT OF RANGELANDS: A REVIEW

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ABSTRACT

Rangelands are regarded as the cheapest sources of forages, supporting over 200 million pastoralists living in close association with about 960 million ruminants. Despite the significant contribution of rangeland to the socio-economic lives of the inhabitants of developing countries, the resource is often abused and neglected in terms of planned utilization, development and management for sustainability. Range improvement programme involves evaluating the contributions of forage species to animal nutrition. Therefore, this review was aimed at assessing and highlighting the contributions of rangeland to sustainable animal production through planned management in terms of stocking rate, grazing capacity as grazing affects multiple rangeland characteristics including biomass, soil nutrients, soil carbon, plant species composition, and forage quality.

Keywords; Assessment, Contribution, Management, Rangeland.

INTRODUCTION

Rangeland is one of the major types of land in the world and they are the principal source of forage for livestock as well as providing habitat for a great variety of native plants and animals (Getabalew and Alemneh, 2019). Rangeland provide ecosystem, goods and services including fodder provision, soil stability, carbon sequestration and maintenance of species diversity, as well as water and climate regulation (Ruvuga *et al.,* 2021). In addition to establishing a functioning ecosystem, rangelands are typically regarded as one of the least expensive sources of roughage for animals, which forms the basis for sustainable animal production (Cinar *et al.,* 2020). In tropical production systems, rangelands constitute the main sources of nutrition for domestic and wild herbivores, which are characterized as lands dominated by grasses, legumes, shrubs or trees (Mosisa *et al.,* 2021). Review of many researches revealed that rangelands cover about 40% of all land surfaces worldwide and 69% of all agricultural land. (Desalew, 2008; Ruvuga *et al.,* 2021).

Some plant species of rangelands are used in landscaping, and as sources of industrial chemicals, pharmaceuticals, and charcoal. Getabalew and Alemneh (2019) also stated that, rangeland is not fertilized, seeded, irrigated, or harvested with machines. For this, livestock grazing often utilizes rotation systems that has been partitioning. However, nowadays, many rangelands support stands of introduced forage species that do not require cultivation. Particularly, rangelands support plant communities that are dominated by species of perennial grasses, grass-like plants (or graminoids), trees, forbs (non-graminoid, dicotyledonous plants), and shrubs. In another research, rangeland ecosystem provides several key services, including medicinal plant production, forage provision, environmental conservation, and soil and water conservation (Odadi *et al.,* 2017) in such a way that users have been able to freely use the services that these ecosystems provide and adapt to changes in ways that have improved their livelihoods (Ruvuga *et al.,* 2021).

Constrains to rangeland

It has been reported that, during the second half of the 20th century in many countries, new changes and challenges emerged, which disrupted the well-adapted strategies and demised the traditional systems of rangeland management. Also, rangeland degradation was followed by livelihoods' vulnerability of rangeland users that affects Sustainable Rangeland Management (Ruvuga *et al.,* 2021), which recently support around 200 million pastoralists living in close association with about 960 million ruminant livestock. Nowadays, these ruminants are under serious threats that jeopardize the services and benefits of sustainable rangeland management (Secretariat of the Convention on Biological Diversity, 2010; Ruvuga *et al.,* 2021;).

Types of rangelands

According to National Research Council and Getabalew and Alemneh, 2019 there are five basic types of rangelands worldwide. These include; Natural grassland, Desert shrubland, Savanna woodland, Forest, and Tundra. *Grasslands* do not have shrubs or trees growing on them. *Desert shrublands* are the most extensive and driest of the rangelands. *Savanna woodlands* are a transition between grasslands and forests and contain herbaceous plants interspersed among scattered, low-growing shrubs and trees. *Forests* contain taller trees growing closer together than in savanna. *Tundra* areas are treeless, level plains in the Arctic or at high elevations of mountains.

Factors affecting the forage nutritive value and productivity of rangeland

a. Climate factors

Climatic factors like temperature, humidity, precipitation, light intensity, and altitude has been control the nutritive value of plants. Although plants are dependent upon the soil for their mineral nutrients, climatic factors affect respiration, assimilation, photosynthesis, and metabolism. The effects are of paramount importance to the extent that the mineral and organic matter content of plants may be strongly modified by climatic factors even though grown on the same soil (Polley *et al.,* 2017).

b. Edaphic factors

The edaphic factors include the physical, chemical, and biological properties of soil that result from biologic and geologic phenomena or anthropogenic activities. Discontinuities in the edaphic factor contribute to the intriguing patterns of diversity we see in the biotic world. Chemical and physical features of soil greatly influence the ecology and evolution of plants and their associated biota. According to Zhang *et al.* (2018), physical properties of soil such as texture and porosity affect the nutritive quality of forage more or less indirectly example, poorly aerated soils greatly limit or decrease the absorption of essential elements, especially phosphorus. A research shown that, trees grown on light soil texture tend to have high fresh biomass yield, dry matter, crude protein, cellulose and crude ash content formation than those grown on heavy textured soil. (Geren *et al.,* 2009).

c. Environmental factors

Getabalew and Alemneh, (2019) mentioned the three most ecologically important environmental factors affecting rangeland plant growth which are; light, temperature, and water (precipitation) and stated that, plant growth and development are controlled by internal regulators that are modified according to environmental conditions.

Rangeland ecology

Rangeland health is a term that is used by range managers to assess the environmental integrity of the land. NRCS (2000) states that, there are three main attributes of rangeland that collectively define rangeland health. They are closely related, yet separate. These are biological and physical attributes which are often used as indicators of functional status of ecological processes and site integrity:

i. Integrity of the biotic community – The capacity of the site to support characteristic functional and structural communities in the context of normal variability; to resist loss of this function and structure due to disturbance; and to recover following disturbance.
ii. Soil/site stability – The capacity of the site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water.
iii. Hydrologic function - The capacity of the site to capture, store, and safely release water from rainfall, run-on, and snow melt, to resist a reduction in this capacity, and to recover this capacity following degradation.

The attributes are susceptible to changes caused by disturbance in climate and precipitation patterns, or disturbance caused associated with land use.

Rangeland conditions

Sustainable rangeland condition is described as the state at which soil integrity and rangeland ecological processes are sustained (Ruvuga *et al.,* 2021). It reflects landscape capacity to perform ecosystem functions, ability to support biodiversity conservation and potential for livestock production (Ondier *et al*., 2019). There is a direct relationship between rangeland condition and productivity. Good rangeland condition can support and improve livestock performance, while livestock grazed on degraded rangeland perform poorly (Odadi *et al*., 2017). Reducing tree cover may increase livestock production without having negative effects on herbaceous forage distribution, though it is not suitable for some rangelands' sustainability (Chinder *et al*., 2020). Overall, dry

rangeland condition varies due to abiotic and biotic factors such as annual rainfall, fire occurrence and grazing livestock distribution (Ondier *et al*., 2019; Pfeiffer *et al*., 2019).

Grazing management

Grazing management involves controlling the number of grazing livestock and their distribution, foraging period and visiting frequency on grazing land. Ideal grazing practices are those which sustain livestock production and maintain rangeland ability to provide other ecosystem services (Di Virgilio *et al*., 2019). Rangeland condition is not affected by livestock grazing when stocking is low to moderate (within rangeland regeneration capacity). Moderately grazed rangeland is dominated by desirable grass species (perennials), good vegetation cover and high forage biomass (Pfeiffer *et al*., 2019). Heavy grazing for long periods is associated with an increase in undesirable plant species, low forage biomass, biodiversity losses, soil erosion and rangeland degradation (Odadi *et al*., 2017). This is because forage off take eventually exceeds forage regeneration rate, so some soil patches are left exposed to the forces of erosion, *e.g.* water, wind and livestock hooves. Excessive grazing of desirable forage species can also reduce their competitive ability over undesirable species, *e.g.* weeds and annual grasses, reducing overall rangeland condition (Chinder *et al*., 2020).

Stocking rate

Stocking rate affects only the proportion of plants likely to be used heavily. Therefore, while conservative stocking is an important first step in sustainable management, it must be applied in conjunction with other management practices like short grazing periods at high stock density (Meshesha *et al*., 2019) and periodic deferment to mitigate the effects of selective grazing (Mulindwa *et al*., 2009). Increasing differences in palatability and abundance among different plants in a pasture, decreasing stock density, or increasing the graze period will tend to increase the likelihood of overgrazing the more palatable plants (Gusha *et al*., 2017). Supplemental feeding, and other management practices that artificially sustain herbivores, break the negative feedback that promotes good range productivity and maintains long-term system stability. In general, strategies to increase cattle production in semi-arid rangelands should be based on the improvement of natural forage production (Diaz-Solis *et al.,* 2006).

Rangeland grazing capacity

Rangeland grazing or carrying capacity is defined as the number of grazing animals that can be supported without serious effects on vegetation cover and other ecosystem services. It is determined by biomass availability at a given time and by the forage demand from livestock. Hence, it varies over time and between different rangelands (Gusha *et al*., 2017). In estimating carrying capacity, it is advised that some of the available biomass be left behind after grazing bouts, to support regeneration and avoid rangeland degradation (Meshesha *et al*., 2019). Forage utilization efficiency (30% for African dry rangeland) is generally used in estimating carrying capacity, so as to retain part of available biomass for rangeland regeneration and to account for uneaten forage due to trampling, urine and faecal contamination, and presence of thick shrubs or other grazing barriers (Dunne *et al*., 2011; Meshesha *et al*., 2019). The carrying capacity of African dry rangeland is commonly estimated using tropical livestock units (TLU), with 250 kg live weight taken as the standard TLU unit. Livestock species have different TLU conversion factors, *e.g.* 1.0 for camels, 0.8 for cattle and 0.2 for goats and sheep (FAO, 1988). Daily dry matter intake is estimated to be 2.5% of live weight, which is equivalent to 6.3 kg/TLU (Meshesha *et al*., 2019). The carrying capacity is calculated per unit area and it is used to plan grazing activities in an area (Sangeda and Maleko, 2018). The carrying capacity of African dry rangeland is reported to be 0.1-1.0 TLU/ha/year, depending on the season and rangeland condition (Sangeda and Maleko, 2018; Meshesha *et al*., 2019).

CONCLUSION

Rangeland is regarded as the cheapest source of forages supporting around 200 million pastoralists living in close association with about 960 million ruminant livestock. Despite the significant contribution of rangeland to the socio-economic lives of the inhabitants of developing countries, the resource is often abused and neglected in terms of planned utilization, development and management for sustainability. Therefore, there is need for proper management and utilization for better animal productivity.

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